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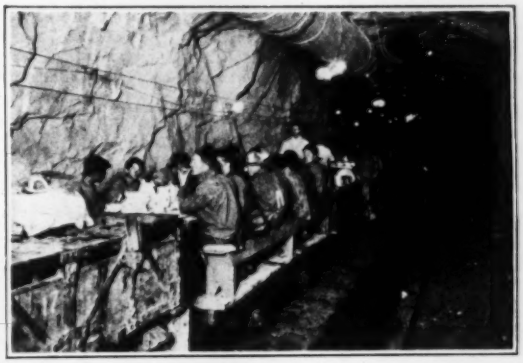
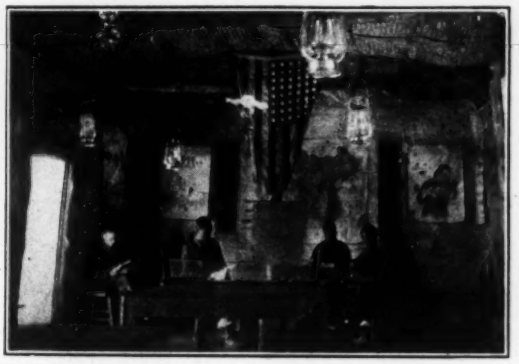
December 20, 1923

Engineering News-Record

Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

SOME of our readers will eat their Christmas dinner two miles underground as are these boys who are digging the Big Creek No. 3 tunnel in California





OTHERS will spend Christmas day in such far away places as this Y.M.C.A. hut for the workers on the Yellow River flood protection work in China

To all its readers—whether in the field or in the family group at home—the staff of Engineering News-Record wishes a

Merry Christmas

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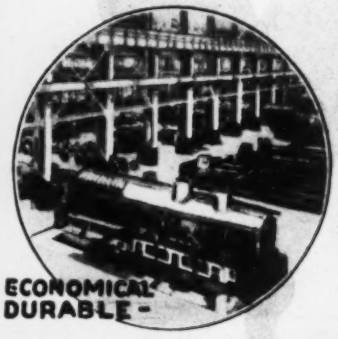
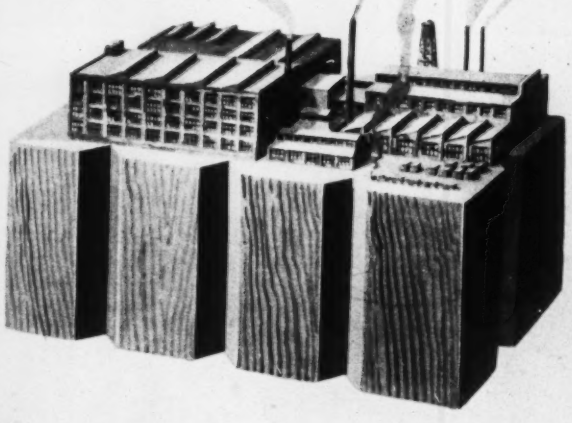


ECONOMICAL DURABLE -



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor
FRANK C. WIGHT, Managing Editor

Volume 91 — NEW YORK, DECEMBER 20, 1923 — Number 25

Good Will Toward Men

ONCE MORE Christmas comes. Once more we do service to that spirit of good will which is the essence of Christmas. In its material form that spirit is strong in the American people. Never was there so charitable a people; never was there so charitable a period. Out of our great abundance we give freely and the hungry and the stricken of the world can bear witness to our good will toward men. In the Christmas time when this material evidence of good will is so strong may we not consider the need for another kind of good will that is just as surely a part of the Christmas and Christian spirit as the open purse and the generous hand. Are we in danger of becoming intolerant? Are we forgetting that respect for our fellows' opinions and beliefs becomes us and helps them just as much as do less irksome aids for the needy and succour for the hurt? We should be a tolerant people. The founders of our nation fled from the intolerance of their fellows to set up here a government where any man might believe as he would and where the majority should rule. On this principle we have prospered. Let us beware lest we forget. In private difference and public quarrel the Christmas time is a good time to take stock of prejudices and to weigh motives. Good will toward men! Charity in act, yes; but more, charity in thought.

A Chapter Closed

IN TAKING over the plant of the Proprietors of the Morris Aqueduct, Dec. 15, Morristown, N. J., closed a chapter in water-works history. Morristown was one of the sixteen municipalities in the United States which had a public water supply at the close of 1800. At that time 15 of the 16 works were privately owned, the single exception being Winchester, Va. One by one 14 of the 15 cities changed to public ownership until from 1896 to a few days ago Morristown was the sole example to the contrary. Why Morristown should have clung so long to private ownership after the other fourteen municipalities changed we cannot say unless its part was to be the exception that proves the rule or unless it was well satisfied with the service rendered by the Proprietors of the Morris Aqueduct. However this may be, four years ago the people of the town voted decisively for municipal ownership, which seems to have been achieved on unusually favorable terms for the public, as may be seen from the statement of the engineer-mayor of the town printed elsewhere in this issue, together with some data regarding the sixteen water-works of the eighteenth century.

The Chicago Typhoid Outbreak

BOIL-THE-WATER notices in Chicago bring back old days. A recent outbreak of typhoid has been confined to the Hyde Park section of the city. It has no adequate explanation as yet. The Health Department declares that the water supply is the cause, specifies the overflow of sewage at one of the Sanitary District pumping stations, a reversal of flow in the Calumet River, outward winds, and recent offshore bacterial studies in support of its conclusion. But on Aug. 11, the whole Chicago River was in reverse flow for six hours, sweeping into the lake many times the volume of sewage that's alleged to have escaped from the pumping station about Nov. 1 but without notable effect on the city's typhoid. Moreover, supposing mass infection in marked degrees resulted from the relatively minor pumping station overflow, how explain why of intakes two hundred feet apart the water from one alone should carry typhoid to the district it supplies? Chlorination and, it seems, water sampling and tests, are done by the Health Department. In the light of present confusing theories and inadequate data, Chicago should make an immediate and searching study, by means of competent experts, to determine whether it is not imperative that immediate steps be taken to join the other cities on the Great Lakes in providing water filtration.

The Roll of Shame

STATISTICS of the motor car killings in the big cities of the country in 1922, just issued by the Bureau of the Census, show that the evils of excessive traffic are increasing. For the 72 cities over 100,000—counting each borough of New York City as a city—the average deaths from automobile accidents per 100,000 population was 16.2 in 1921 and 16.9 in 1922. In fifty-two cities the number of deaths increased and in twenty they decreased. The worst offender continued to be Los Angeles, which not only topped the list with 29.5 deaths per 100,000 but exceeded its own record killing of 1922 by 2.4, dropping only slightly below its rate of rise of 3.0 for each of the preceding three years. Two smaller cities, Camden and Memphis, came next but they apparently had bad years for their prior records were not so high. The same is true of Atlanta and Baltimore which are fourth and fifth, with the same rate of 24.7. Low rate cities—below 14.0 and consistently so—are Albany, Fall River, Indianapolis, Jersey City, Milwaukee, New Orleans, Bronx and Queens

boroughs in New York, Omaha, Philadelphia, Portland, Ore., Richmond, Va., Seattle, and Spokane. There is something more than coincidence in the continued high or low rate of automobile killings in a city. A visit to the two cities and a knowledge of their people tell in themselves why Los Angeles is the biggest killer and Philadelphia among the smallest. Fair traffic rules honestly observed and rigidly enforced may not save all the lives that are being lost from the coming of the automobile but they will save many. The cities who top this roll of shame must sooner or later come to see it.

Train Spacing or Engine Signals

FAILURE of the engineman of the 20th Century Limited to observe and act upon the automatic signal indications in last week's accident at Forsyth, N. Y., is being used, and rightly so, to emphasize the need of automatic train control, but in so doing it is quite possible that another important feature of the accident will be entirely overlooked. It is the evidence of how insufficient was the space interval between the sections of the train. The flagman was only a short distance from the rear of his train when the following section passed him, so short a distance that any effort he could make was fruitless.

The lack of such space interval between trains is not peculiar to the Forsyth accident; it is common to all of our railroads which handle a heavy passenger traffic and is the result of the more crowded railroads' inability to handle the peak load passenger traffic with their present trackage without running passenger trains in sections close to each other or causing the passengers considerable delay and inconvenience. The operation of regular trains in sections is not inherently wrong. In fact it is safer than running extra trains. The wrong lies in operating the sections close together in order to increase the peak capacity of the trackage and to satisfy the demand that all sections of an advertised train reach their destination as close as possible to the schedule time.

The result is that we have trains traveling at 60 miles an hour only four or five minutes apart, *sometimes less!* Under such conditions no amount of human or mechanical vigilance will prevent a repetition of the Forsyth accident. Automatic train control will reduce the number of such accidents but will not prevent them. Moreover such a system of train control is bound to decrease the vigilance of the enginemen and to increase their dependence on a mechanical device that by its very nature will not be put to the test of operation until the very time that it is most needed. The existing automatic train control devices are largely new and untried. Legislation making their use obligatory before they have been given severe tests under actual operating conditions might easily result in increasing rather than decreasing the number of rear-end collisions or similar accidents.

The road to accident prevention lies in so increasing the space interval between passenger trains that when a train is delayed or stopped there will be sufficient *time* for the crew to protect their train against the failure of the following engineman to observe, or of the mechanical devices to respond to, the danger. And that means some reduction in peak-hour track capacity and some inconvenience to those passengers who do not buy the early reservations on the popular trains.

Reclamation's Trial Balance

IN THIS issue appears the concluding one of a series of nine articles begun Oct. 25, in which men of special knowledge have reviewed the great enterprise of federal arid-land reclamation. The preceding articles outlined its development; this week Congressman Addison T. Smith of Idaho, himself a settler on irrigated land and now chairman of the House committee on irrigation of arid lands, sketches some future needs and possibilities. Together, the articles direct the reader's thoughts to the present problems of reclamation and the broader problem that lies just ahead.

A large responsibility confronts the American people. Reclamation of land by national enterprise has reached the end of an epoch. The easily irrigable lands, the readily available waters and the eager settlers of prior years are no longer at hand. Much land still awaits reclamation, but it presents new and far more difficult conditions. Are we to go forward? And are we to do so by the methods of the past? The people must decide. The issue involves the sound growth of the nation.

Hitherto the subject has not received much attention from the men in the eastern half of the country. Most of them have thought of it hazily as the building of great works somewhere in the West. Nor for that matter has the average Westerner been adequately familiar with it, for land reclamation is vast and complex. A wise policy, however, must root in sound public opinion. It is our hope that the articles now concluded may help to disseminate the information from which such opinion may be formed.

The future attitude of the country toward reclamation involves questions of great moment, which we hope to discuss briefly later on. Our present concern is whether the past twenty years' work in reclamation has been successful or not. Has the enterprise been mismanaged, as the Secretary of the Interior claims? This must be answered before it is possible to think constructively of future policies. The answer is found in the facts set forth in the articles, and in supplementary field observations reported in a series of letters written from a staff survey, which also closes in the present issue.

Reclamation is shown to be an over-all success. It has developed thousands of farms and homes, and produced hundreds of millions of dollars worth of food supplies. It has enriched the West in values and in money by an amount many times greater than the sum invested by the nation. It has done its work at moderate cost, and by processes of high efficiency and virile honesty. It faced extreme difficulties, and dealt with conditions and problems incomparably greater than those of private irrigation. Federal reclamation took up those developments that were too difficult for private enterprise; it watered the land at no greater construction cost than private undertakings, at equal or lower operating cost, and with even-handed fairness and efficient service to the thousands of farm families for whom it was undertaken. Seen at large or in detail, the facts consistently show that planning was far-sighted and able, that construction was of high quality and low cost, and that operation was efficient and economical.

This is the broad showing of reclamation's trial balance. There have been those who impugned the record

on the ground that some structures were too costly and others not good enough. There have been those who pointed with reproach to a leaky reservoir bottom in gypsum, to a canal or a dam damaged by landslips, to valves and conduits which wore out rapidly while serving under unprecedented conditions, to wells which did not yield the expected amount of water, to unforeseen gas and water troubles in driving a tunnel, or to occasional cost figures exceeding anticipations based on different conditions. Fair consideration of all the facts, we are sure, will lead the impartial observer to dismiss many of these reproaches as unfounded, and to accept the others with feelings of relief and surprise that so few mischances, errors and unforeseen obstacles should mark the history of a great pioneer undertaking.

The facts also show that both the operation and the construction phase of reclamation are permeated with engineering requirements to a degree that makes engineering direction essential to good results. This conclusion applies throughout, from project management to direction of the Service as a whole. Herein will be found one of the important lessons for the future, and a damning reflection on the course now pursued by the Department of the Interior in resorting to politician management in the guise of "business administration." Political exploitation of farm development spells destruction.

Reclamation has had its troubles, however, and has them today. When it invited the pioneer to take up its lands, it failed to remove from his path the traditional hardships and often miseries of pioneering; and all the curse of those hardships and miseries has been visited upon it. On the urgent plea of land owners and promoters who desired the government to better their fortunes it went out into the West and built dams and canals, only to find itself drawn into a struggle against the cupidity of the owners, who seized upon the increase in land value without paying for the works. It not only lost the struggle but in addition it made enemies of those with whom it fought. Reclamation was planned to subsidize the settler seeking a home on the land; in a large measure it has subsidized the money-lender and the land speculator instead.

Moreover, weakly or sympathetically reclamation went far outside its field. Though intending to do no more than build irrigation works, it soon became a retailer of water; and, unlike a public-utility company, it was burdened by its governmental character and by interference from Congress and the executive department to the degree that it was unable to collect its water charges regularly. Thus it fell into the part of philanthropic guardian of the irrigators. It was wholly unequipped to deal with a hundred thousand obstreperous wards, who would not operate their water-supply, would not drain their lands, and would not co-operate in developing the farming methods needed to suit the special conditions of their situation. And, while still in this guardian position, it encountered an agricultural crisis of unparalleled severity, all of whose evil effects were charged against the sins of reclamation. Normal governmental mechanism is not constructed to cope with such difficulties.

At the bottom these evil results are chargeable to reclamation itself. To carry out its purposes under the conditions that had to be met it needed to apply a more fatherly care of its wards, coupled with effective control. Neither was provided for in the law or in the administrative policies based on it. Departmental government along conventional lines is not adapted to paternalistic functioning. Now that we may look back at the experiences of a generation it seems clear that in undertaking to assure the growth and good fortune of far-spreading pioneer communities as it did, without co-operation of local government, the federal government engaged in what was really a colonial adventure, one to which ordinary administrative methods were wholly unsuited.

The faults back of this condition are not due to engineers, however. They were committed by the government itself, by the statesmen and officials of administration after administration. If what was done is an indictment, it indicts the governmental principles on which reclamation has been built up. It indicts bureaucratic and Secretarial management, and demonstrates that technical control must be supreme if so great an enterprise is to make consistent progress. For many reasons, therefore, a new reclamation policy is called for. To spend the nation's wealth for further reclamation development until such new policy is established would invite disaster.

In the meantime it is gratifying to observe that the present reclamation projects have largely worked through their difficulties, and as a whole no longer constitute a problem. It is true that the reclamation farmer is not in a comfortable position, but he is only in the same plight as other farmers, and for the same reasons; the general farmer needs help but he cannot be helped by tinkering with reclamation debts. The difficulties and hardships due to reclamation itself have been overcome. There are, however, detail problems in the various projects. Most of these problems will work out successfully under present laws and administrative methods. Others may be relieved by improving the present law and strengthening or broadening the local administration accordingly.

Such adjustments as these are required: Individual deferment of the government debt of some farmers is called for as a matter of sound and fair business. Blanket deferment such as legislated in the past two years and again proposed in Congress has been shown to be thoroughly unsound, and in the present juncture would be little short of calamitous; but Congress should authorize individual extension of payments for cause, on businesslike terms. Provision should be made for removing serious injustices now existing, by giving authority to adjust the debts according to variations in land quality and climate. Authority should be given for writing off certain lost investments that have been made in the course of the reclamation development, in order that the clouded title of some of the projects may be cleared. Finally, agricultural promotion work is needed on the projects, to support the government's desire that the projects become prosperous farming communities and its demand that the loans be repaid.

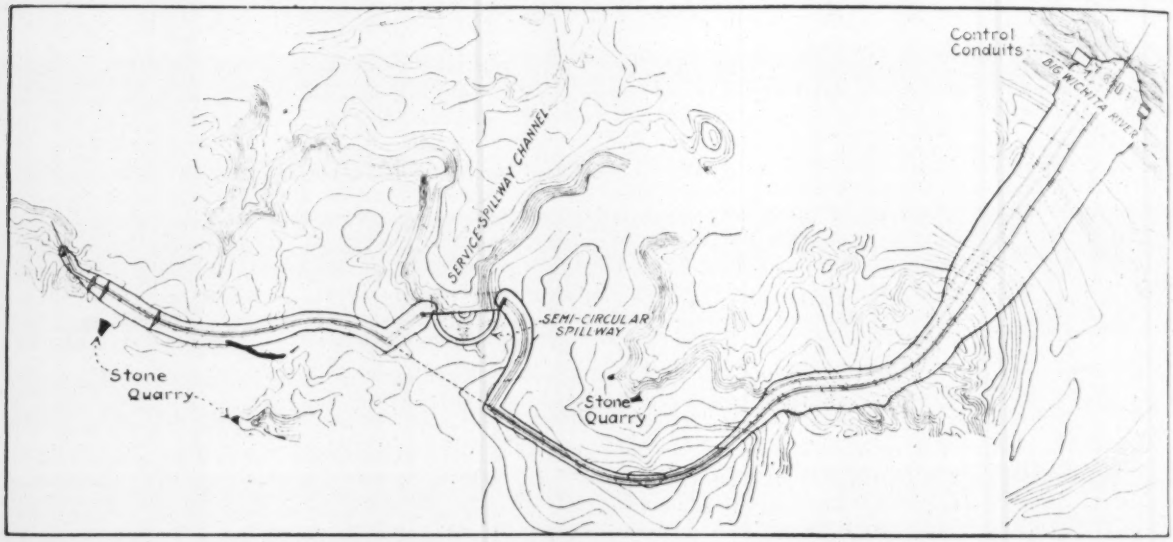
Under capable engineering management, such measures will assure the fuller success of the reclamation development created by the labors of twenty years. It is for Congress to enact these measures into law and thereby take the final step in realizing upon the country's reclamation investment. It is also for Congress to give tardy recognition to the engineering responsibilities of reclamation by requiring the Service to be under direction of a competent technical authority and preventing its being the plaything of party politics.

Fast Hydraulic Filling of the Wichita Falls Dam

Monthly Lifts of 12 Ft. Each Were Made with Material Consolidating Immediately and Supporting Dragline Throwing Up Levees for Pool

BY ALBERT S. FRY AND R. A. THOMPSON AND O. N. FLOYD
Morgan Engineering Co., Memphis, Tenn. Chief Engineer and Assistant Chief Engineer Wichita Co. Water Improvement District 1, Wichita Falls, Tex.

THE HYDRAULIC fill storage dam of the Wichita County Water Improvement District 1, 40 miles west of Wichita Falls, Tex., is practically completed. As noted in *Engineering News-Record*, June 21, page 1080, the main structure is 7,500 ft. long, has a 100-ft. maximum height and contains 1,500,000 cu.yd. of fill, of which 1,285,000 cu.yd. was placed by hydraulic dredge and the remainder by teams. A second article, in *Engineering News-Record*, June 28, page 1118, described the flooded dry-fill diversion dam 15 miles downstream from the storage dam. This third article deals mainly with the construction of the storage dam which was carried up at a rapid rate by means of an electrically-operated hydraulic dredge built within the reservoir where was found an almost ideal material for quick consolidation. Wooden bulkheads retained the pool on the upstream side; on the downstream side it was retained by levees thrown up by a small dragline excavator. Riprap on the semi-circular spillway slope consists of a thick rubble paving of limestone cap rock found on the site while on the water face of the main dam an 18-in. hand-placed layer of the same material was used.



STORAGE DAM OF WICHITA COUNTY WATER IMPROVEMENT DISTRICT 1

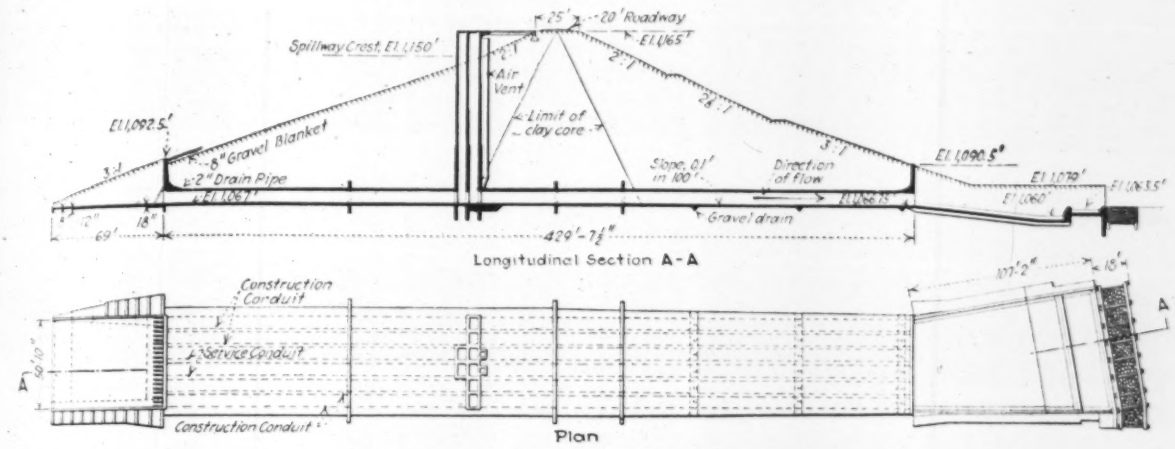
The storage dam is located 8 miles from Mabelle, the nearest station on the Wichita Valley R.R. At the beginning of construction, a road was built from this point to the dam over which to transport equipment and materials. Most of this road was on the top of a divide and no grading was required except at a few steep places which were cut down by a 1-cu.yd. gas crawler tractor shovel as it was being moved in.

Conduits—At the dam site the river channel is close against the south side of the valley and the six 7-ft. circular reinforced-concrete outlet conduits, 430 ft. long, which carry the stream flow during construction and which will later control the outflow from the reservoir, were located in the south bluff. It was necessary to place the conduits in this location in order to secure a good foundation although so doing required the excavation of a large volume of material from the side of the hill. The upstream entrance to the conduits is protected by precast oval-shaped reinforced-concrete guard bars. The outlet is designed to provide for the control of the hydraulic jump and reduction of the velocity of the water from the conduits to a safe velocity for the river channel below the dam. All corners around which water must flow were rounded to reduce friction losses.

Four of the conduits, built for construction purposes only, will be sealed after the main dam and spillways are completed. It was necessary to build six conduits to provide capacity for passing such floods as might occur during construction, and this provision has proved ample. The two center conduits, which are the permanent service conduits, are each fitted with two cast-iron gates with bronze facings to control the outflow.

Air ducts were constructed for the two service conduits to introduce air below the point of regulation of the main gates to prevent disturbances in the flow through the gates and injury to the gates themselves. Each duct consists of a concrete well 3 ft. square, built on the downstream side of the gate tower.

Core Trench—A core trench was excavated under the dam for its entire length except across the river channel and the service spillway. Across the river valley this trench is 20 ft. wide at the bottom, has side slopes of 1 to 1, and was excavated to the level of the bottom of the river. Steel sheetpiling was driven in the center

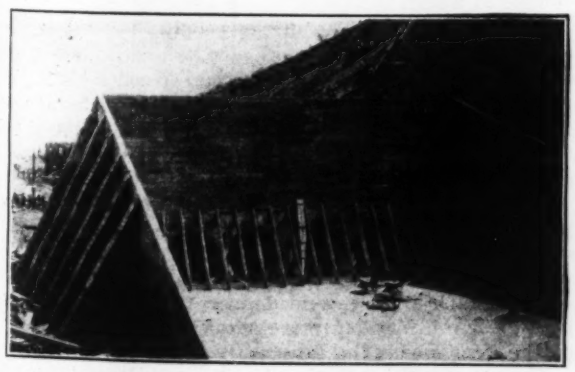


CROSS-SECTION OF DAM AND PLAN OF CONDUIT

of this trench to a penetration of from 4 to 5 ft. into a shale formation. The sheetpiling was driven from the north side across the river valley and channel to the south toward the conduits.

After the river channel had been closed off, following the driving of the sheetpiling, an embankment was built with teams out of carefully selected material, suitable for core purposes, on the lower side of and against the piling for support when the lake was formed upstream for floating the dredge. This fill was built in wagon lifts, carefully wetted and puddled next to the piling. The subsequently placed hydraulic core extended entirely over and encompassed this material, care being taken to be sure that the material used to back up the sheetpiling became thoroughly saturated and incorporated into the core of the dam as the hydraulic fill was placed. The river channel was closed at a time when the river was practically dry and after the conduits had been completed so that whatever flow there was in the river was diverted through the conduits.

A cutoff trench was excavated under the part of the embankment beyond the river valley into impervious clay or shale. The depth of this trench was sufficient to insure the intercepting of any pervious strata through which the water might flow under the dam. This trench was filled with core material placed by the hydraulic dredge for the hydraulic fill section of the dam and was filled with selected material and puddled to the height of the original ground surface for the section of the dam constructed by teams.



INLETS TO FOUR CONSTRUCTION AND TWO SERVICE CONDUITS THROUGH THE DAM
Rounded bars guard entrance to conduits having rounded ends

Hydraulic Fill—Material for the hydraulic fill was dredged from the river valley above the dam. The material in the borrowpit is mostly a rather fine sand containing probably 25 per cent of clay and very fine sand suitable for core purposes. Ordinarily the dredge takes a cut of this material from 30 to 45 ft. deep and in this depth there are usually encountered one or more layers of stiff red clay from a few inches to a few feet thick. Occasionally small layers or pockets of gravel are struck and sometimes a few large boulders. The accompanying table shows the results of mechanical analyses of material in the slopes of the core and the dam:

MECHANICAL ANALYSIS OF MATERIALS

Sieves	Near Outer Slope	Midway Between Core and Slope	Near Core	Core
Through ¼-in. mesh and on 10-mesh	0.0	3.0	9.4	0.0
Through 10-mesh and on 20-mesh	1.1	4.0	2.6	0.0
Through 20-mesh and on 40-mesh	20.4	41.2	20.0	0.0
Through 40-mesh and on 80-mesh	59.6	46.0	48.1	2.7
Through 80-mesh and on 200-mesh	16.3	4.6	8.5	32.1
Through 200-mesh and on 0.04 m.m.	2.6	0.2	1.4	23.1
Smaller than 0.04 m.m.	0.0	0.0	0.0	42.1

The figures given are the average from three samples, taken Dec. 15 and 31, 1922, and April 1, 1923. The material retained on the 10-mesh sieve as shown in columns 2 and 3 was largely clay balls. Samples of the sand or slope material taken from time to time as the dam was built up showed no particular change but the samples of the core showed that the material in the core gradually became coarser as the dam rose and the core pool became narrower. This material makes a compact and stable fill. A team can be driven over it either wet or dry without sinking into it more than an inch or two.

Ball Test—After the large cutoff trench was filled, there was a slight excess of core material which, of course, was desirable as it eliminated danger of sand slides into the core. While the core was from 80 to 100 ft. wide and the cutoff trench was being filled a 6-in. cast-iron ball would sink into it from 12 to 17 ft. When the dam had reached a height of from 25 to 30 ft., this softer material had been crowded out and the ball showed a penetration of only 6 to 8 ft. below the water surface. The penetration decreased as the height of the dam increased and near the top the ball would sink only 2 or 3 ft. As the top of the dam was approached, the proportion of core to the balance of the fill diminished considerably. This caused more core

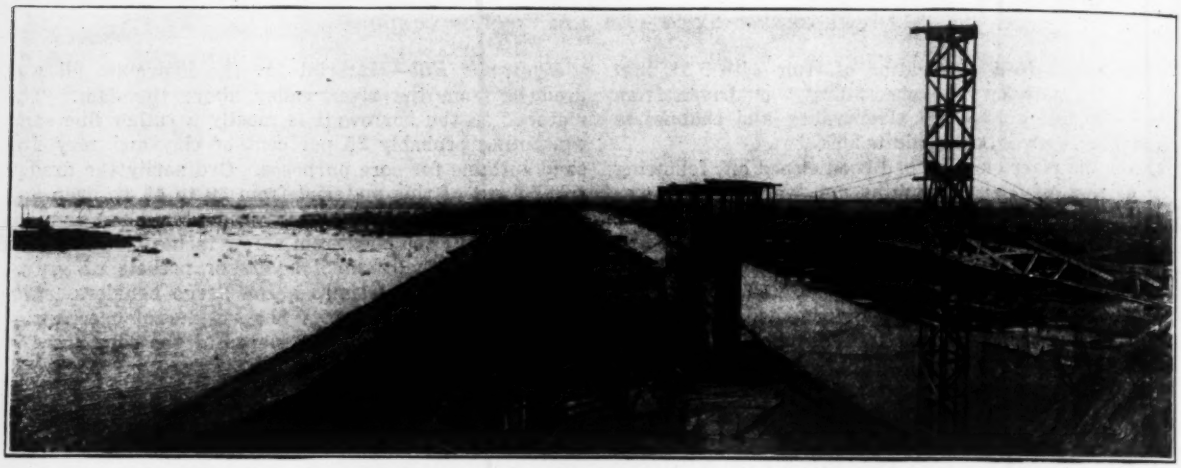
material to be wasted which in turn caused the core to be stiffer as the fine particles went out first.

On the night of April 11 the core pool broke through or over the downstream levee near the north end of the dam, making a gap 24 ft. deep at the toe of the slope and extending about 15 ft. back into the core. A section of the core about 15 ft. high was exposed. This stood up in excellent shape. The core was very stiff and broke off in large blocks as the supporting sand was washed away. The core stood with face 8 to 12 ft. high practically vertical except for the large blocks at the toe which had broken off and slipped down. A cubic-foot sample weighed 140 lb.

Dredge Operation—While the conduits were under construction, a launching pit was excavated by a dragline machine in the floor of the river valley a short distance above the dam, and a hydraulic dredge was assembled in this pit. The dredge is 111 ft. long and is equipped with a 42-ft. beam and a hull 9½ ft. deep. Northwest fir was used in building the hull. A ladder 75 ft. long, built up of 30-in. I-beams and cast-steel saddles carries the cutter head and suction pipe. The two wooden spuds are 26 in. square and weigh 9 tons each. The dredge was operated with electrical power brought in over a transmission line from Wichita Falls 41 miles away. Transformers located on the south side of the river reduced the 38,000-volt current to 2,300 volts. Twin submarine cables carried the power from the transformers to the dredge. The dredge was launched May 30, 1922, and began operating on Sept. 11, 1922.

The dredge pump is of the centrifugal type direct-connected to a 1,600-hp. motor and is run at 360 r.p.m. The pump is designed for necessary pipe friction plus a maximum lift of 65 ft., the difference in elevation between the top of the dam and the surface of the ponded water during the final stages of construction. The manganese-steel pump shell has cast-iron side liners which can be replaced when worn out. The runners are cast steel and range in size from 54 to 64 in. In the beginning the smallest size was used and the larger ones were put on from time to time to take care of the increased head as the dam became higher and longer. When the dredge pump had handled almost a million yards, the shell was so badly worn that sectional cast-iron liners were made and bolted in all the way around so as to enable the same shell to finish the job.

The dredge has a daily capacity of 10,000 cu.yd. and pumped about 200,000 cu.yd. per month for the first four months. After the dam became high and narrow the various delays reduced the monthly output considerably. The vertical rate of progress on the dam for the first five months was about 12 ft. per month. This decreased to about 8 ft. per month during the latter stages of the work due to delays and increased length of dam. With the possible exception of the river section of the Taylorville Dam on the Miami Conservancy District, it is believed that no other hydraulic fill dam has been brought up so rapidly. In spite of this unusual speed, however, there has never been the slightest indication of any lack of consolidation of the core or slopes, and it is the opinion of the engineers on this dam that a hydraulic fill dam, if properly handled, will consolidate as fast as it is practicable to deliver the material and build it up. The slope material is as compact the moment it is placed as it ever will be and the core consolidates by the water being forced up through the newly deposited mud because the weight of any good core material is at least twice as heavy as an equal volume of water.



HYDRAULIC FILL STORAGE DAM UNDER CONSTRUCTION

Bulkheads were used on upstream side and levees on downstream side. Concrete tower built the six conduits and the gate and air tube shafts. Sheerboards were placed along edge of pool to prevent formation of tongues of sand.

Pipe Experience—The discharge pipe was made up of 20-in. 10-gage riveted-steel pipe, which is unusually large for hydraulic dam construction. Wooden pontoons were used for floating the pipe across the lake above the dam. The shore pipes were slip-joint sections 20 ft. long. The pontoon pipes were 32 ft. long and were connected by rubber sleeves.

As the principal wear is on the bottom third of the periphery the pipes were turned so as to even up the wear. The average life of the shore pipe on this job was about 600,000 cu.yd., but even after that much service patches were welded over the holes, and the pipe gave considerably more service out near the end of the lines where the pressure was not great.

The velocity through the pipe line was from 10 to 15 ft. per second. Apparently 10 to 12 ft. per second would be sufficient, but there was no provision for con-

trolling the speed of the motor and a runner large enough for the longest line of pipe had to be kept in the dredge pump. Therefore, on the short lines it was inevitable that too much water was pumped.

During the first stages of construction, the fill material was confined by wooden bulkheads about 4 ft. high and stepped to form the required slopes. It was later found to be more advantageous to confine the material by a levee thrown up by a small dragline machine operating on the outer edge of the fill. However, because of the amount of lumber purchased for bulkhead construction, the bulkheads were continued in use on the upstream slope and the dragline levees were used on the lower slope. The material is discharged from the pipe near the outer slope of the dam and flows toward the core pool in the center of the dam, grading hydraulically. The width of the core at any elevation has been made the same as the height of the dam above that elevation.

During the early stages of construction, the pool was drained by means of a timber spillway over the side of the embankment into the lake. This proved unsatisfactory, however, as the dam attained size, and vertical wells or sumps built up as the height of the dam increased were constructed within the fill with pipe outlets to the upstream toe to provide for the return of the pool water into the lake. Inasmuch as all of the water is returned to the lake above the dam there has always been sufficient water to maintain operations even during the driest season.

As the embankment and core pool rose and narrowed it was necessary to use care to prevent tongues of sand from shooting out into the pool. Boards were placed about 5 ft. back from the margin of the pool to deflect the water, reduce velocity and prevent sand being carried out into the core.

Wooden racks bordering the pool were used for storing discharge pipe when not in use.

About 4,500 ft. of the main dam containing 215,000 cu.yd. lie north of the hydraulic fill. This is a low section averaging about 20 ft. in height and has been placed by teams and dump wagons using elevating graders.

Service Spillway—The service spillway is located across a canyon just north of the main body of the dam. A semi-circular hollow concrete dam forms the crest of the spillway from which a sloping paved discharge channel leads into a deep pool, the bottom of which is some 50 ft. below the present ground surface, 5 ft. below river bed and 90 ft. below the spillway crest. The downstream side of the pool, formed by the natural shale which occurs here, was excavated to a ¼ to 1 slope. Water flowing over the spillway will discharge into this deep stilling pool and will then flow off over the natural shale rim of the pool, down the canyon into the channel below.

The design of this spillway was adopted after a consideration of various types of structures, and was influenced to a considerable extent by the character of the material through which the canyon leading from the spillway down to the river is cut. This material is a very heavy shale with occasional thin layers of sand and limestone. When exposed, the shale disintegrates slowly to a shallow depth and it is expected that when there is a flow over the spillway the disintegrated shale will be washed away and a new surface of shale will be exposed to the atmosphere after the flood has passed. This action will occur after each flood, but many years will elapse before the bed of the canyon below the spillway is cut down to river level, and there will be ample time for observing conditions and taking such measures as may be necessary to prevent destructive action at the lower end of the spillway.

SEMI-CIRCULAR SERVICE SPILLWAY BEFORE ERECTION OF HOLLOW DAM AT CREST

After dragline was used in excavating the slope the heavy riprap was placed and the interstices were filled with concrete. Mixer plant at left chuting concrete to place. Shale (at left) will not be excavated but left to disintegrate.

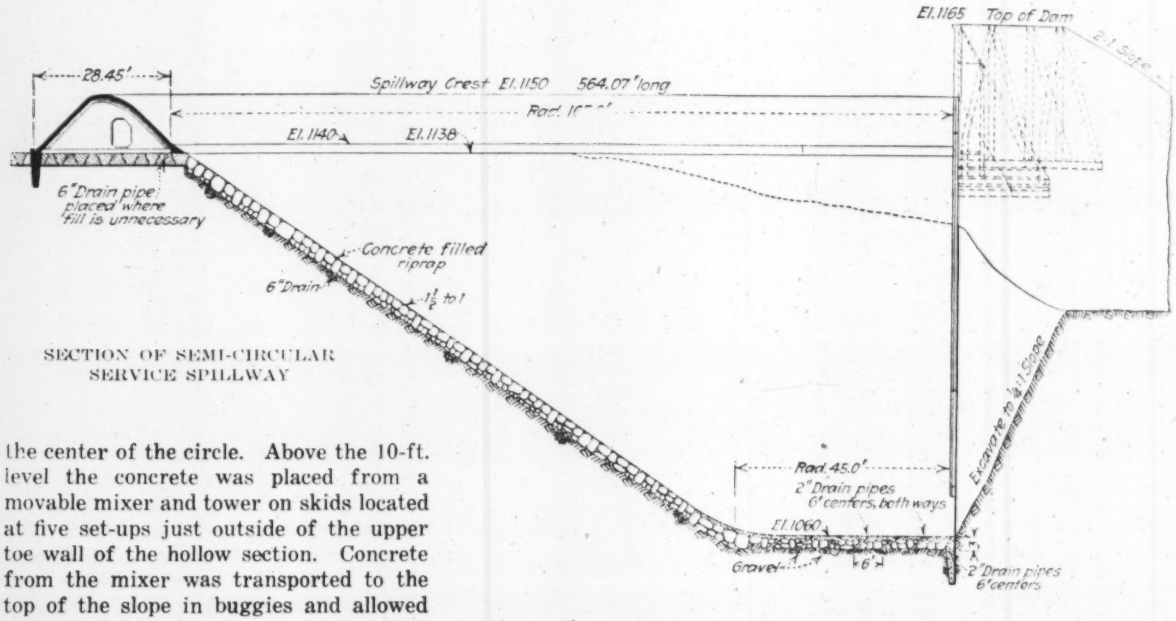
The depth of the stilling pool was determined by the velocities which will obtain in the canyon below the spillway when the natural surface below the spillway cuts down to the bottom of the stilling pool, the depth being such that the velocities in the canyon, when this has taken place, will not be sufficiently great to cause damage.

The excavation for the service spillway was made by dragline and gas shovel. The dragline has a 70-ft. boom and 2½-cu.yd. bucket operated with distillate oil. All the material that could be reached conveniently by a dragline was removed by that method. Operating on the upper rim of the spillway, the excavated material was placed in a spoil bank above the spillway and some of it was later loaded with the gas shovel onto wagons and used in the wings adjacent to the headwalls. Material taken out with the dragline from the lower side of the spillway was wasted below. The dragline and shovel worked in conjunction, each machine being used when it could be operated to best advantage. Long lines were used on the dragline bucket, which

enabled it not only to remove material from the bottom of the excavation but also to strip the slopes of the excavation from the bottom.

The rock for the rubble paving for the floor and slopes of the spillway came from a limestone stratum of cap rock about 30 in. thick found near the spillway. This rock was broken out with light charges of black powder and required very little stripping before being quarried. The rock was placed with the dragline from which the bucket had been removed. Holes were cut into the rock with a jackhammer for inserting hooks to insure safety in placing.

The concrete in the floor cutoff walls and slopes of the spillway to a height of about 10 ft. above the floor was placed from a mixer located on the lower side near the center of the circle. Above the 10-ft. level the concrete was placed from a movable mixer and tower on skids located at five set-ups just outside of the upper toe wall of the hollow section. Concrete from the mixer was transported to the top of the slope in buggies and allowed to flow down the slopes as the voids in the rock were filled. The flow was directed by men with shovels and other men with rods worked the concrete into the open spaces in the rock. The spillway concrete slope paving was divided into sections about 10 ft. wide to facilitate construction. A slightly wet mixture of 1:2:4 concrete was run in first to fill up the voids between the rocks. This was followed with a rather dry mixture placed on top and troweled into place, giving a fairly smooth surface.



SECTION OF SEMI-CIRCULAR SERVICE SPILLWAY

Emergency Spillways—The emergency spillways, located at the extreme north end of the dam, consist of two sections of earth dam, for which the crest has been lowered, confined by headwalls so that they will be the only parts of the dam to give way during extraordinary floods. The first emergency spillway is 70 ft. wide and its crest is 7 ft. below the top of the dam. The second emergency spillway is 335 ft. long and its crest is 4½ ft. below the top of the dam. The riprap paving which is used on the upstream face of the dam is extended over the upper slope of the emergency spillways. The water will be flowing over the service spillway 8 ft. deep before the first emergency spillway would go out and 10½ ft. deep before the second one would come into action. In the event that the emergency spillways are washed out they will be washed down only to the underlying limestone rock which is near the surface where the spillways are built and no appreciable volume of stored water will be lost.

Riprap—The upstream face of the dam is protected by a layer of limestone riprap 18 in. thick placed by hand. The spaces between the stones are rammed full of spalls with a sledge down to the 8-in. gravel blanket which underlies the riprap. This riprap will give better protection and is less expensive than a thicker layer of rock loosely dumped. The rock for the riprap was quarried from the cap rock ledge of limestone in the vicinity. A gravel blanket with minimum thickness of 8 in. was placed on the upstream slope of the dam under the riprap. It was obtained from a gravel bed on the slope of the hill at the north end of the hydraulic fill.

Materials—Coarse aggregate for the conduits was crushed limestone shipped in by rail from Chico quarry, about 125 miles south, and was hauled from Mabelle station to the dam in wagons. The coarse aggregate for the concrete for the spillways was obtained from a pit located at the end of the hydraulic section of the dam. A gravel washing and screening plant was installed and the bank gravel washed and screened. The sand used in the spillway concrete was a by-product of this washing.

R. A. Thompson is chief engineer for the district and in direct charge of the work. O. N. Floyd is assistant chief engineer. The Morgan Engineering Co. is consulting engineer, L. L. Hidinger, president, giving immediate supervision. The general contractor for all of the work is the Callahan Construction Co., of Dallas, Tex., from whom the Puget Sound Bridge & Dredging Co. of Seattle, Wash., subcontracted the hydraulic fill.

Motor Vessel Use Increases Ten-Fold

The annual report of Lloyd's Register shows that in July, 1923, 1,831 motor vessels were in use in the United States, with a gross tonnage of 1,668,414. This compares with 297 motor vessels in use in 1914. Of the 1,831 in use in July, the sizes run: 60 over 6,000 tons; 65 between 4,000 and 6,000; 87 between 2,000 and 4,000 tons, and the remainder less than 2,000 tons.

Simple Balancing of Quantities in Highway Grading

Special Tables Afford Quick Preliminary Estimate —Reduction of Irregular Sections to Level Sections Required

By Fred. M. Garnett

Office Engineer, State Highway Department of Georgia, Savannah, Ga.

WHETHER there should be strict adherence to the practice of balancing quantities in highway grading is a debatable question. When possible, however, this office balances quantities thereby avoiding unsightly borrow pits and waste banks along the right-of-way. The method employed has been used for more than a year on various projects in the division, and whether the cross-sections are fairly level, irregular, or very irregular the results attained are well within the limits of expectation. Indeed the method has proved to be practical, economical, and simple, within its scope of application, under widely different topographical conditions.

This method relies largely upon the use of three tables. First, a table of yardage per 100 ft. is required, with which every engineer is acquainted, and which is extensively used in almost every highway engineering office. Second, a table of areas for regular trapezoidal sections in fill is prepared, giving areas for sections from 0.1 ft. fill to 15.0 ft. fill; this table is made to conform with the standard type of roadbed adopted. Third, a similar table is prepared for regular level sections in cut. By the use of these two tables areas corresponding to any cut or fill between 0.1 ft. and 15.0 ft. can be rapidly taken off, and used in computing the yardage, together with the yardage table already mentioned. The procedure is as follows:

After having plotted the profile, decide upon the economical and advantageous limits of haul. These points are noted as shown in Fig. 1, referred to as balance points. Next endeavor to set tentative grades so that the cuts and fills will balance between these points. In Fig. 1 is shown a profile of a portion of Project S-8-108, Toombs County. It was decided to try and balance the quantities between stations 145 and 170. The tentative grade was set as shown with the object of balancing quantities.

A preliminary computation of quantities was next made between these balance points by use of the three tables described. On the preliminary computation sheets are recorded the cut or fill as the case may be for each station between the two balance points. These cuts or fills are at the center of each section and are the difference between the elevations of subgrades and the elevations of the profile. The areas corresponding to the cuts and fills are taken directly from the table of areas, and are used in conjunction with the yardage table in computing volumes.

After having made a preliminary estimate of the quantities, they were compared and it was found that there was an excess of 1,235 cu.yd. of cut. The final grade was adjusted as shown in Fig. 1 to eliminate this excess material. Had there been a preponderance of cut over fill, the grade between stations 158 and 170 could also have been adjusted. From experience, or by means of a rough calculation, it is easy to determine how much a grade should be adjusted to balance the quantities. Since the objective balance points were selected at stations 145 and 170, by referring to the mass diagram shown in Fig. 2, some idea can be gained as to the practical working value of this method. The mass diagram shows that a balance point occurred at station 146 plus 70 instead of at station 145, and at station 169 plus 80 a balance point occurred instead of at station 170. From station 131 to station 349, a distance of 21,800 ft. on this project, no borrow or waste whatever was incurred, and economical haul was obtained.

This method of balacing quantities is not designed or intended to be absolutely accurate, since the areas were computed for regular level sections in the preparation of the tables.

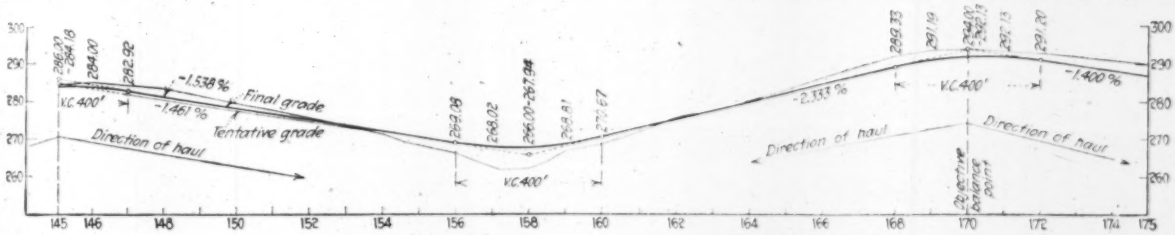


FIG. 1—PROFILE INDICATING PROCEDURE IN BALANCING QUANTITIES

If the cross-sections are very irregular as shown in Fig. 3, they can be approximately reduced to level sections by means of a thread or triangle placed across the sections as shown by the line *XY*, so that the material above this line will balance the material below this line, making the necessary correction at the center, according to whether this balance line is above or below the original cut or fill shown on the preliminary computation sheet. The corrections are added to or deducted from the original values, and the volumes determined as described.

FIG. 2—MASS DIAGRAM

This method is based upon the premise that all sections are regular level sections, but such is not always the case; however, by reducing irregular sections to level sections as described, a fair working approximation can be obtained, and much of the guess can be taken out of the work.

In using this method it is not necessary to templet the cross-sections in computing the preliminary quantities; neither does the planimeter have to be used in conjunction with preliminary work. After the preliminary work is finished, the final quantities are computed and recorded on the final computations sheets, but it is not necessary to transfer the areas from the cross-

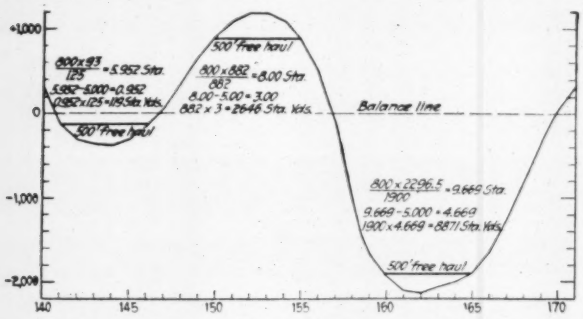


FIG. 3—LEVELING UP IRREGULAR SECTION

section sheets to the computation sheets, since only the volumes are required in computing the mass of ordinates. Much time can thus be saved, and the chances of errors minimized. The final yardage is computed from planimetered areas.

The two tables of areas can be used to good advantage in checking planimetered areas, by reducing irregular sections to level sections as heretofore described and reading the areas from the two tables. This work is only approximate, but errors of a serious nature can be readily and rapidly detected.

One of Oldest Private Water-Works Taken By City

WHEN the Proprietors of the Morris Aqueduct handed a deed of their property to the authorities of Morristown, N. J., on Dec. 15, the last of the fifteen privately owned water-works in the United States at the close of 1800 was transferred to municipal ownership. As shown by the table herewith, there were only sixteen water-works in the United States at the close of the eighteenth century and of those only the one at Winchester, Va., was municipally owned.

The transfer of the Morristown water-works comprises the entire holdings of the company, including the sources of supply and the distribution system, the latter extending into some outlying territory. The population of Morristown in 1920 was about 12,500, but it is estimated that from 18,000 to 20,000 people are supplied by the Morristown water-works. The following information regarding the purchase, together with some information regarding the early history of the plant, has been supplied to *Engineering News-Record* by Clyde Potts, civil and sanitary engineer of New York City, and mayor of Morristown:

The transfer marks the close of more than four years of negotiation with the company. On Sept. 9, 1919, the people of Morristown voted decisively to own their water-works. It was only during the past summer that negotiations were completed for the purchase of the present system. The purchase price of $686,000 was based on an appraisal made by Willis H. Dutton, chairman of the water committee in 1920, in which pre-war prices were used. The original appraisal was $605,000, to which $81,000 was added for extensions and some undeveloped sources not included in Mr. Dutton's appraisal.

The Morristown water-works is one of the oldest in the United States. It was built in 1799 under a charter granted by the State of New Jersey to the Proprietors of the Morris Aqueduct, dated Nov. 16, 1799. The plant has been reconstructed a number of times since then and at the present time the plant on the whole is up-to-date.

The original plant was an aqueduct four miles in length, including its various branches. The water supply was drawn from springs 100 ft. above the town on the Jockey Hollow Road, about a mile distant. The main supply line from the springs to the town was constructed of tile pipe, later replaced with chestnut logs, with a 2-in. bore. The original work was completed on June 20, 1799, by Pelatiah Ashley of West Springfield, Mass.

The annual gross earning of the plant is $80,000. It is anticipated that the town will be able to pay operating and interest charges from the earnings, and apply from $18,000 to $20,000 to the retirement of the bonds.

The final column of the accompanying table shows the years in which the fifteen cities mentioned above as being under private ownership of water-works at the close of the eighteenth century changed to public ownership. No change was made until 1828. Between then and 1848 there were three changes. In the full decade immediately preceding the Civil War there were five more changes and in the Civil War decade itself no changes whatever in ownership. From 1871 to 1896 there were six changes, thus leaving Morristown for the twenty-seven years the sole remaining town of the original fifteen under private ownership during the past twenty-seven years.

WATER-WORKS IN THE UNITED STATES AT THE CLOSE OF 1800

Location	Date Built	Change to Public Ownership	Order of Change	Change Year
Boston, Mass.	1652	1848	Lynchburg	1828
Bethlehem, Pa.	1761	1871	New York	1843
Providence, R. I.	1772	1871	Boston	1848
Geneva, N. Y.	1787	1896	Albany	1851
Plymouth, Mass.	1796	1855	Worcester	1852
Salem, Mass.	1796	1873	Hartford	1854
Hartford, Conn.	1797	1854	Plymouth	1855
Portsmouth, N. H.	1798	1891	Newark	1860
Worcester, Mass.	1798	1852	Bethlehem	1871
Albany, N. Y.	1798 or 1799	1851	Providence	1871
Peabody, Mass.	1799	1873	Salem	1873
New York, N. Y.	1799	1843	Peabody	1873
Morristown, N. J.	1799	1923	Portsmouth	1891
Lynchburg, Va.	1799	1828	Geneva	1896
Winchester, Va.	Before 1800	(Always public)	Morristown	1923
Newark, N. J.	1800	1860		

Summary By States

New Hampshire	1	Connecticut	1	Pennsylvania	1
Massachusetts	5	New York	3	Virginia	2
Rhode Island	1	New Jersey	2		
				Total	16

According to "The Manual of American Water-Works for 1897" there were in the United States at the close of 1896 a total of 3,196 "complete works" supplying water for both domestic and fire protection uses, of which about 53 per cent were under public ownership. Complete figures for later dates are unavailable, but of the 4,437 works listed in the McGraw Waterworks Directory for 1916 about 70 per cent were under public and 30 per cent under private ownership.

Slide Movement in Gaillard Cut

On the morning of Oct. 28 a slide involving from 250,000 to 300,000 cu.yd. of material developed on the west bank of the Panama Canal in Gaillard Cut. It was approximately 1,100 ft. long and at the point of greatest encroachment extended 150 ft. into the channel. There was ample width and depth to the east of the slide for the passage of ships of any draft, but to facilitate the work of the two dipper dredges engaged in clearing the channel, ships in transit are assembled on either side of the obstruction and held until a specified time in the afternoon when the dredges are shifted and the waiting vessels pass through. There has been no enlargement of the slide subsequent to the original movement, and it is estimated that six weeks will be required to clear the channel entirely.

Sir William Mackenzie

An Appreciation of his Greatness as a Railroad Builder and his Solidity as a Man

By Henry K. Wicksteed
Toronto, Canada

THERE LIES buried today in the churchyard of his native village, a remarkable man, justly appraised by the public press as one of the "makers of Canada"—the same public press which a few years ago was anathematizing him in connection with the Toronto railway deal as the cold-blooded head of a soulless corporation.

Sir William Mackenzie was born in 1849 in the village of Kirkfield, 88 miles northeast of Toronto, of Scotch parentage, in humble circumstances. His birthplace was in those days just as much a frontier settlement as are the outlying villages around Sudbury today or those along the North Saskatchewan farther west. Young Mackenzie grew up to manhood in this frontier settlement. He received the ordinary education of a Scotch boy, an education which evidently included the shorter catechism, for while he never in later life showed outwardly much religious feeling in the ordinary sense, he was always aware of his debts and obligations, and he learned Scotch thrift and economy. In my personal intercourse with him I found him always keen and apparently hard as nails in driving a bargain and holding the "weather gage" of a rival business man. He was almost penurious in his personal habits and tastes, but this was quite compatible with extreme generosity and kindliness towards old friends of himself and his family who had been less fortunate than himself in the accumulation of this world's goods. His dislike for ostentation and display amounted to passion.

Young Mackenzie taught school for a time and engaged in mercantile business. In the early 70's one of the pioneer narrow-gage lines, the Toronto and Nipissing, pushed its way into the pineries from the neighborhood of Toronto, and it was here that he got his first experience of railroading. About the same time the "Northwest" as the central prairie belt of Canada was then called was opened up for settlement and the Canadian Pacific Ry. was initiated by the federal government. Young Mackenzie had imagination, and these signs of progress evidently fired it and stimulated him to greater things. In the 80's he went West and followed railroading almost exclusively. He did some contracting and lumbering in the mountains of British Columbia, and also on the "Short line" of the C. P. R. in Maine, and in the latter case he was one of the few contractors who carried his work through and made some money out of it.

It was at this period that he became associated with D. D. Mann—Mackenzie and Mann soon became a recognized Canadian institution. In 1890 Mackenzie became impressed with the possibilities of electrification in connection with urban railways and carried through successfully that of the Toronto system. This was his first notable success and it merely paved the way for greater enterprises. Towards the end of the century Mackenzie and Mann took up the charter of a small branch line in Western Manitoba. Instead of selling it to the C. P. R., which had now become a dominant element in the Northwest, they elected to hold and operate it themselves, and engaged D. B. Hanna, another Scotchman, as manager. To their surprise the concern paid its way in the very first year, and this became the inspiration and the nucleus of the Canadian Northern Ry. The subsequent history is a romance which will be written some day.

The acquisition of the Manitoba, Southeastern and Ontario and Rainy River charters, and the extension of their Manitoba line to Lake Superior formed a second "Granger" line to Great Lakes navigation. There followed the expropriation of the Northern Pacific Canadian lines by the Manitoba government and their lease to the Canadian Northern, and the latter became a power in the prairie country and extended westward through Saskatchewan and into Alberta. But the end was not yet, the Canadian Northern was handicapped by being a "Granger" road pure and simple and lacked eastern connections. Negotiations with the Grand Trunk fell through. Mackenzie had conceived the idea of a transcontinental line and was bound to carry it out. The Grand Trunk wanted to buy, and failing to arrange, played on the vanity of the powers at Ottawa, and the National Transcontinetal and Grand Trunk Pacific deal was the result. This was the beginning of the end and the rest is current history. Mackenzie built his through line at a fraction of the cost of the rival, but the western country was as yet too poor to support both. The final crash was hastened by the war, itself brought on by rivalry and vanity and thirst for power.

Mackenzie's personal vanity was absurdly small. His desire was for achievement. Money was merely a means to an end. Quick and hot-tempered, he was always amenable to argument and reason, and some of the pleasantest hours of my life, possibly of his own, have been spent in poring over maps and plans with him, and formulating development schemes. How much of his success was due to personal magnetism, how much to the spirit of romance and adventure which hung over the whole project, is hard to say, but he had in a rare degree the gift of putting the right man in the right place, and implanting and retaining loyalty in his subordinates. The loyalty was not only to himself and his partner and the enterprise, but it bound the heads of the different departments together as actual friends. Never was there an organization with fewer internal jealousies and rivalries. Unquestionably much of his success is due to this. He heartily appreciated the man who as a matter of principle could fight him with his own weapons.

The Toronto mayor who drove a hard bargain with him over the Toronto Ry. franchise became a warm friend and later manager of the system. How much, again, of his success was due to his partner, D. D. Mann, of different temperament, but with profound knowledge of railway construction and of men is hard to judge. And last, but not least, how much was due to the gracious lady, his wife, a native of his own village, who rose with him, and was for years the chateleine at "Benvenuto," his Toronto home, and a recognized society leader in the truest sense!

Dravo Contracting Co. Built South St. Bridge

The statement in *Engineering News-Record*, Nov. 22, 1923, p. 861, regarding the opening of the city-built bascule bridge over the Schuylkill River in Philadelphia at South Street, should have named the Dravo Contracting Co., Pittsburgh, as contractor, instead of the American Bridge Co. The Dravo Contracting Co. had the entire contract, but sublet some of the construction to the American Bridge Co.

Concrete Aggregate Produced From Local Deposit

High Cost of Imported Stone and Sand, and Uncertainty of Transportation, Lead Contractor to Screen Gravel on Job—Cubic Yard Cost Far Below Cost from Outside Sources

By J. Arthur Garrod
General Superintendent, Aberthaw Construction Co., Boston, Mass.

IN APRIL, 1922, the Aberthaw Construction Co., of Boston, Mass., was awarded a contract at Northbridge in Southern Massachusetts, for constructing three buildings for the same owner requiring aggregates for some 11,000 cu.yd. of reinforced concrete. The original estimate contemplated the use of 1¼-in. crushed stone for coarse aggregate, with a reduction in price if similar sized gravel was substituted. It was decided by architects to accept the proposal for the use of gravel. Crushed stone, as specified, would have cost $2.35 per ton f.o.b. cars near the main part of operations. Gravel screenings were offered at $2 per ton on cars, and would have cost still more if the architects' requirements to use all 1¼-in. stone had been strictly enforced. Good concrete sand was offered at $1.75 per ton on cars at the job.

When plant requirements were surveyed it was found that all the side-tracks in the immediate vicinity of the job would be required for the handling of cement, so that unloading space for aggregate, and machinery for unloading, if provided, would have to have been at some distance from the sites of the four mixers used on the widely separated buildings. Railroad conditions, although unsatisfactory at the time work was started, showed signs of becoming more so; so that the use of local materials, even at the same price, was most desirable.

Preliminary Examination—An examination of all developed and some undeveloped deposits within a three-mile radius showed several possible sources of supply, two pits proving superior to all others. Both of these contained excellently graded material. The pebbles in both pits had an adhering coating of clay, a coating which was not present in harmful quantity in the sand. This material could be purchased at 10c. per cubic yard, bank measurement, all overburden removed being deposited on the premises and only the quantity actually taken away to be paid for. One of the two deposits had been worked intermittently for years; the other deposit had been worked on a previous occasion but a large knoll was practically unexplored. Eight test holes showed excellent gravel in sufficient quantity but with two to three feet of overburden. The first-mentioned deposit was finally decided upon as it was located nearer to a good road and within 1,500 ft. of the Blackstone River.

A trucking concern interested us in a method of screening with the aid of portable gasoline-driven belt conveyors. They guaranteed to supply coarse aggregate at $2.50 per yard, and fine aggregate at $1.50 per yard delivered at the site, two miles from the pit. A week's trial showed we could not rely upon their method: the sizing of the coarse aggregate was not acceptable; oversize stones cluttered the pit; the adhering coating of clay was not loosened from the stones; the usual controversy commenced regarding the size of loads, so the Aberthaw company decided to erect a plant and prepare the aggregate by its own forces.

A sample of the sand showed a tensile strength of 110 per cent of Ottawa standard sand, so the architects decided that the finer material was suitable without washing. Screen analyses of the pebbles showed them to be well graded, and examination showed them to be of more than average hardness. As some 10 per cent were larger than was permissible in the concrete, a crusher was needed. The architects required that the coarse aggregate be washed free from the adhering coating of clay.

The outlay for a special washing and sizing plant for treating the material would have been large and would not have been justified on account of the temporary nature of the installation. The Aberthaw company then decided to install used crusher, elevators, screen and pump stored at the time in their Boston yard. The electric service company was ready, for a small installation charge, to provide supplementary transformer facilities and to supply power at the current authorized rates.

Design of Plant—The job force, under the writer's direction, proceeded to design the plant and bins and to obtain the most suitable equipment available at Aberthaw's yard.

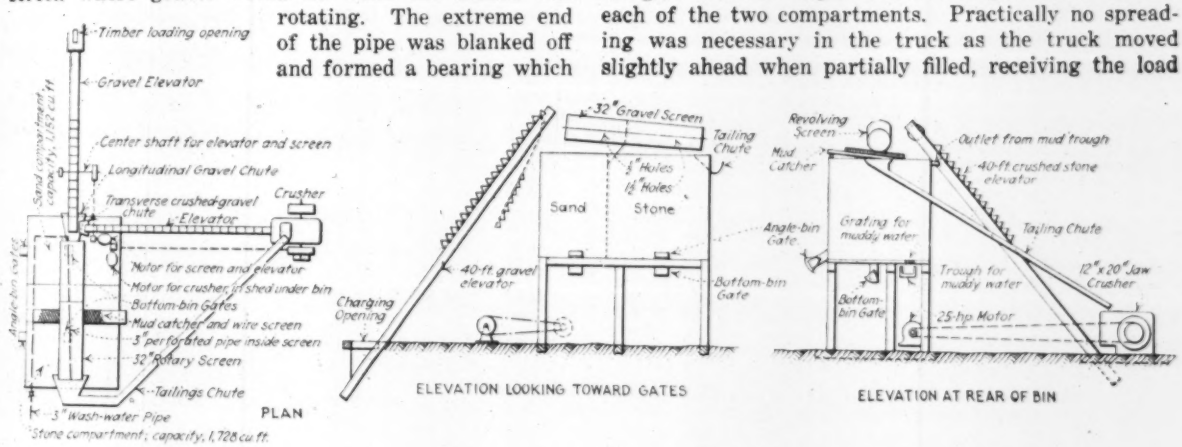
The rotary screen, erected lengthwise of the bins, was 32 ft. in diameter and 16 ft. long; the upper 7 ft. of this screen was perforated with ½-in. holes, the remainder with 1½-in. holes.

A bin and gate were used at first for feeding the boot of the elevator but this was found unnecessary as an 8-in. x 12-in. timbered opening at the floor elevation of the pit gave a fairly regular supply of material and enabled the horse scrapers to be dumped directly over it. The excavated gravel was raised with a single chain bucket-elevator having 15-in. buckets spaced 12 in. c. to c. on the chain. The elevator fed the gravel through a chute 3 ft. long, at a 45-deg. inclination, to the head of the screen. The total height between the bottom-shaft and head-shaft of the elevator was 40 ft. The sand was screened dry and the 40 per cent sand determination, made at the beginning, remained fairly constant throughout the operation. The bin was partitioned accordingly. Oversize pebbles or tailings remaining on the screen were conveyed to the crusher through metal-lined gravity chutes. A 10-hp. motor supplied all necessary power for this screening and elevating outfit.

The jaw-crusher had a 12-in. x 20-in. opening and a rated capacity of 12 tons per hour. It was set on a concrete foundation at right angles to the direction of the screen. The product of the crusher was raised by a bucket-elevator similar to the one which raised the gravel. Crushed pebbles and stonedust were dumped from the head of the elevator into a short chute at right angles to the long chute which fed the gravel

from the main elevator to the screen. The clean angular stones and stonedust from the crusher, thus introduced into the gravel, assisted materially in both dry and wet screening operations. A 25-hp. motor, belted directly to the crusher, supplied power to both crusher and elevator. At no time was this crushing outfit used to capacity but both fine and coarse aggregates were improved by the addition of the material resulting therefrom.

To remove adhering clay from the stone, streams of water were played upon the coarse aggregate from a heavy 3-in. pipe, 16 ft. long, which was introduced at the head end of the rotary screen. The portion of this pipe which corresponded with the 1½-in. holes in the screen was perforated with a double row of ⅝-in. holes spaced 1¼ in., the aggregate area of the openings being slightly larger than the pipe diameter. The pipe was turned so as to direct the water against the sector of screen where gravel would lie when the screen was rotating. The extreme end of the pipe was blanked off and formed a bearing which



PLAN AND ELEVATIONS OF ABERTHAW GRAVEL SCREENING PLANT AT NORTHBRIDGE, MASS.

carried the pipe on the revolving shaft which supported the back end of the screen. Some of the perforations were subsequently plugged so that the largest streams of water were concentrated near the middle of the screen.

Water for washing purposes was pumped from the Blackstone River about a quarter of a mile away, the water being handled by a large-periphery single-stage centrifugal pump adapted for high lifts. A 10-hp. motor was belted to this pump and gave ample power. The total head, including the usual allowances for friction and bends, was 45 ft. The water was conveyed to the gravel plant through a 3-in. steel pipe, purchased second-hand. As the installation was temporary and not designed to operate in freezing weather the pipe was laid over the ground. The waste water from the washing operation was designed to fall out through a grating towards the back of the coarse aggregate bin and run through a surface ditch to an abandoned canal which formed an excellent sedimentation basin. The water which reached the river contained no mud or suspended matter.

Plant Operation—Difficulty in operation was at first experienced as the screened gravel in the bins became contaminated by the dirty water from the washing. This was later obviated to a large extent by the introduction, near the center of the bin, and immediately under the screen, of a trough formed of a 15-in. structural steel channel covered with a stout galvanized mesh with wires ⅞ in. apart, this mesh being arranged with a sharp slope to either side of the trough so that the muddy water would pass out comparatively free from sand grains. This modification enabled us to produce a clean coarse aggregate under normal running conditions. Some clay from the water which had been used for washing was still accumulated in the coarse stone remaining in the bin when bin-gates were operated normally. During repairs, when it was necessary to empty the bins, this clay was removed by thoroughly washing with a hose and nozzle connected with the wash-water supply.

The bin was 20 ft. long, 12 ft. wide and 12 ft. deep. It was built of second-hand yellow pine timbers and local hardwood plank. It was arranged so that trucks could back up under the side opposite the crusher, leaving the head end free for the screen, and the lower end free for handling the tailings. One bottom circular bin-gate and one angle circular bin-gate were used in each of the two compartments. Practically no spreading was necessary in the truck as the truck moved slightly ahead when partially filled, receiving the load evenly. The truck drivers left their cabs to operate the bin-gates but without descending to the ground. The ground grade was arranged to slope away from the bins. The floor of the gravel pit was above the grade of the highway, so the trucks were not delayed in loading or getting away.

It was found that one man could attend the entire plant and take care of the tailings, except when the material in the bank was wet following a rainstorm. The plant was placed against the available faces in the gravel pit so that some excavation was necessary to make room for the crusher and the bottom of the gravel screen. A 15-ft. depth of face was available when operations started. From 12 in. to 18 in. of loam and other overburden had been removed and care was taken that the material fed to the plant should include due proportions of the various strata. At first the feeding was done by hand-shoveling from the immediate vicinity of the elevator boot. After a few days this was supplemented by a pair of horses and a drag scraper, a method of excavation used exclusively thereafter. Near the end of the operating period the haul to the boot averaged 250 ft. Five was the maximum number of teams and scrapers used at any one time. As the haul became greater wheel scrapers were tried, also a much advertised kerosene-driven tractor, without and with crawling traction. The soft underlying sand made the hauling too heavy for wheel scrapers and did not afford

proper traction to the tractor, so these methods were not adopted. Some form of dragline excavator was carefully considered but on account of the wide angle it would have been necessary to cover this method was not considered economical.

Production and Handling—A larger amount of sand was produced by the screening plant than was needed for concrete. To handle this surplus an occasional truckload was removed from the bin and deposited on the floor of the gravel pit near the road. To make the maximum use of this sand and to facilitate handling, two 16-in. x 24-ft. portable electric-driven belt conveyors, with low belt-cleats, were purchased. One of these had a device for screening the surplus concrete sand into peastone or torpedo sand for granolithic finish, and finer material for brick mortar. These conveyors loaded trucks from storage piles economically but the screening device was of little use as a small amount of moisture in the sand prevented its further separation. Most successful operation was attained during long spells of dry weather. These conveyors were readily moved around within the pit but it is extremely doubtful whether the results obtained justified the expenditure made for their purchase and upkeep.

The two-mile haul from the pit to the mixers was accomplished by 3½-ton dump trucks hauling about 4 cu.yd. per trip. These were hired at $2.50 per hour including driver, fuel, oil, etc. No serious mechanical difficulties attended the use of these trucks and the road, although hilly, remained in fair condition throughout the season. Some scraping with a road drag had to be done on a stretch of unimproved highway near the pit during spells of wet weather. No accident to persons or property attended the operation of the trucks although the route traversed was through the principal business street of the town.

The overburden excavated was 1,100 cu.yd., which was left in the gravel pit; 12,451 cu.yd. of material were measured in the bank and paid for; and 272 cu.yd. of prepared material were sold at the gravel plant and trucked by others. The cost of preparing this material and the price received for it have been excluded from the figures tabulated. Of coarse aggregate 244 cu.yd. remained in the gravel pit as a surplus when concreting was completed. All surplus fine aggregate was trucked to the job as backfill and is included in the 14,309 cu.yd. reported.

The maximum storage around the mixers which could be used economically would care for one day's run only, so that during the active period of the job it was found necessary to install incandescent and flood lights at the gravel pit and to run during the night as well as during daylight hours to provide sufficient aggregate for the daily scheduled runs of concreting. The labor cost of night operation averaged one-third higher, when work was running well, than during the daytime; and occasional breakdowns, when the needed help to make unusual repairs was not immediately available, still further increased costs.

The plant was in operation June 7 and work of dismantling was started October 17, a period of 18 weeks. Allowing for Sundays and wet weather, an average of 143 cu.yd. of both coarse and fine aggregate was produced daily, including about 30 nights when gravel was produced and transported.

During wet weather the sand would not separate in the dry screen and some few loads had to be re-screened by hand to enable proportioning to be consistently accomplished at mixers.

The quality of the material was maintained throughout; 1:3 briquettes made with the sand averaged well over 100 per cent of Ottawa standard. An occasional batch of 1:2:4 cylinders was made, which, when crushed at 28 days, gave average strengths of over 3,000 lb. per square inch compared with the average of under 1,900 lb. obtained from aggregates from the same pit before the plant was operating.

The estimated and actual costs are tabulated above.

Average Cubic Yard Cost—From the table of comparative costs it will be noted that the average cost of coarse and fine aggregate delivered by trucks at the mixers was $2.055 per cubic yard. No direct comparison can be made with other sources of supply as no concern or concerns were found who could supply gravel screenings as required. The one concern which did bid, was tried and proved unsatisfactory. Acceptable crushed stone could have been purchased for $3.13

TABLE — ESTIMATED CONTRACT COST OF GRAVEL AND ACTUAL COST WITH SCREENING PLANT ON JOB

Performance	Estimated Cost	Actual Cost	Actual Unit Cost per Yard of Material Del'd at Mixers	Saving	Overrun	Remarks
1. Labor stripping bank, 1,100 cu.yds.	$1,200	$529	$.037	$671		Overburden piled on premises
2. Labor on plant unloading, erection, maintenance, dismantling and loading	1,825	2,196	.154	....	$371	Includes lubrication, repairs and upkeep
3. Labor of operation, including foreman, teams and men loading and handling, 14,309 cu.yds. of coarse and fine aggregate	6,609	10,663	.745	....	4,054	Estimated 13,217 cu.yds. @ 50c.
4. Trucking aggregates from pit to mixers, 14,309 cu.yds.	7,930	8,222	.575	....	292	Estimated 13,217 cu.yds. @ 60c.
5. Proportion of overhead at main job office	....	570	.040	....	570	Includes watchman Sundays and holidays
6. Electric power and installation, including wiring for motors and lights	800	1,195	.084	....	395	Amount of salvage received allowed for
7. Plant rental	2,600	2,235	.156	365	....	Crusher, screens, elevators, pumps, repair parts and renewals on rented equipment
8. Lumber for bins, bolts, nails, etc.	500	456	.032	44	....	Amount of salvage received allowed for
9. Pipe for wash water supply (2nd hand)	200	206	.014	....	6	Amount of salvage received allowed for
10. Two portable belt conveyors	....	918	.064	....	918	Includes freight from factory and allowance received for salvage
11. Freight, express and trucking on equipment	250	303	.021	....	53	From Boston and return
12. Sundries, including hand tools, horse scrapers, bin-gates, grease, oil, waste, etc.	50	664	.046	....	614	Amount of salvage received allowed for
13. Paid to owner of pit for material removed	860	1,245	.087	....	385	12,451 cu. yd. bank measurement
	$22,824	$29,402	$2.055	$1,080	$ 7,658	
Overrun	6,578	....	....	6,578	....	
	$29,402	$29,402	....	$7,658	$7,658	

per cubic yard f.o.b. cars, plus an estimated cost of 50c. for unloading and trucking to mixers. Freight conditions during the construction period were such as would have made it hazardous to rely upon obtaining aggregates by rail, and the absence of unloading facilities would have made it extremely difficult to receive the material by cars even though car service had been satisfactory.

Thus assuming that crushed stone at the above price and sand by cars at $2.33 per cubic yard could have been made available, and the unloading from cars and trucking to mixers could be accomplished at 50c. per yard, the average price at the mixer would have been $3.36 per yard against the actual cost recorded—$2.055 per yard. Similarly, assuming that gravel screenings could have been obtained at $2.66 per yard f.o.b. cars with 50c. for unloading and trucking, then the average price of screenings and sand would have been $3.16 against the $2.055 actually obtained.

Alum, an Aid in the Filtration of Activated Sludge

Sanitary District of Chicago Finds Alum Success at Three Plants with Advantages Over Use of Acid

UNIFORM success in the use of aluminum sulphate in the pretreatment of activated sludge for pressing has been attained at three sewage treatment plants of the Sanitary District of Chicago. Alum is found preferable to acid as an aid to filtration since it is safer to handle, it decreases time of filtration, it is as cheap, gives a clean filtrate and it is not necessary to control the amount within narrow limits. F. W. Mohlman, chief chemist, in a paper presented recently to the American Chemical Society at Milwaukee, described experiences of the past year with alum, mostly with plants of full-size working scale, at Des Plaines, Calumet and Argo. An abstract of his paper follows:

Des Plaines Works—Approximately 3,000 lb. of dry activated sludge is produced daily at the Des Plaines works. As removed from the aeration tanks the moisture content averages 98 per cent, although it frequently is as low as 97 per cent. Sludge is removed for pretreatment from the Dorr thickeners daily and stored in rectangular tanks containing filtros tile aerators. From these storage tanks the sludge is pumped directly to the filters.

When the press house was put in operation, in September, 1922, two types of presses were available. The first was a 120-plate Simplex press, a typical recessed-plate filter press with a special type of grooved recess. A perforated sheet-metal plate was riveted over the grooves on which the filter cloth rested. The plates were center-feed. The thickness of the cakes was 1 in., and the filtering area was 1,815 sq.ft. Pressure could be built up to 125 lb. per square inch. The Worthington platen press, similar to the one used at Milwaukee in 1918, held eighteen bags, each 5 x 8 ft. in area, supported between perforated platens. The filtering area was 1,440 sq.ft.

The first few pressings were made with untreated sludge. The bags soon clogged, and slimy cakes were produced, even with a long pressing of from 7 to 8 hours. It became increasingly difficult to handle the sludge produced.

Acid was used for a number of pressings, and as far as practicable the pH was adjusted to the optimum value, approximately 3.5 as shown by laboratory tests with Buchner funnels. Results were very unsatisfactory, with wet slimy cakes and dirty bags. It was necessary to press 24 hours per day, with a chemist present only during the day shift, consequently perfect adjustment of the acidity could not be obtained.

A marked improvement in filtration was noted immediately on the use of alum. The cakes were dryer, time of filtration was shortened and the bags were cleaner. The use of alum was so satisfactory that it was adopted as routine procedure in the pretreatment of sludge.

The comparison of the relative efficiency of acid and alum for pretreatment, shown in the table, was obtained by filtration of 250 c.c. of treated sludge through a battery of Buchner funnels, using a sludge with 99.06 per cent water.

TABLE—RELATIVE EFFICIENCIES OF ACID AND ALUM FOR PRETREATMENT OF ACTIVATED SLUDGE

Sulphuric Acid—66 Deg. Bé			Filter Alum		
c.c. per Gal.	Time of Filtration Min. and Sec.	pH	Lb. per 1,000 Gal.	Time of Filtration Min. and Sec.	pH
0	7:30	7.1	0	8:00	7.1
1	10:15	6.2	3	2:00	6.7
2	9:30	5.3	6	1:50	6.4
3	6:00	4.3	9	1:40	6.2
4	5:00	3.2	12	1:30	6.0
5	4:00	2.5	15	1:15	5.8

These results have been verified a number of times, and show facts which indicate why alum has proved so much more satisfactory than acid. An insufficient amount of acid, or a drift back to a pH between 5 and 6 may actually cause an increase in the time required for filtration. On the other hand the addition of even small amounts of alum produces a sharp decrease in time of filtration, with little tendency toward deflocculation, and at no time an actual increase in time of filtration The curve shows no "humps," and no sharply defined iso-electric point. Similar results have been noted by Van der Meulen and Smith in experiments on the use of alum for coagulating Imhoff sludge.

Laboratory tests, proved by months of practical operation, have shown that the sludge may be too concentrated for effective use of alum. These observations have resulted in the following procedure for the pretreatment of the sludge: The sludge is drawn into the storage tank, where its moisture content is determined approximately by means of a special hydrometer which has been calibrated by many tests on sludges of various moisture contents. If the apparent moisture content is below 98.5 per cent, effluent or city water is added to bring the moisture up to that point. Alum is then added, never more than 10 lb. per 1,000 gal. If possible the sludge is used up within 6 hours; if it has to stand 24 hours more alum is added.

The pH is usually decreased to 5.8 to 6.0, at which point practically all the alum is precipitated as $Al_2(OH)_6$. It will be noted that the function of the alum is thus as a coagulant used in water filtration, and not for its salt effect, after the iso-electric point has been obtained by the use of acid. Much lower amounts are required if alum is used as outlined than if acid and alum are used together.

The amount of alum left in the sludge as a diluent of the valuable nitrogenous material is absolutely negligible. At the rate of 10 lb. per 1,000 gal. of 98.5 per cent sludge, only about 30 lb. or 1.5 per cent of Al_2O_3 will be added to a ton of dried sludge.

Alum has been used as described above since October, 1922, with uniform success. We encountered no so-called "winter sludge"; pressing and pretreatment were for practical purposes just as satisfactory in January and February as in July and August. We did, however, encounter a period of difficulty in April, 1923, when we attempted to cut the air in the aeration tanks to the minimum amount capable of giving an effluent that would not decolorize methylene blue in less than 8 or 10 days. We gradually reduced the air to as low as 0.66 cu.ft. per gallon, but as we cut the air the nitrates in the effluent were reduced from 7 or 8 p.p.m. down to 1 or 2 p.p.m. The effluent was still clear, but stabilities began to drop off. The main difficulty was noted in the filtration of the sludge Although the same pretreatment was continued, in fact the alum dosage was increased, slimy cakes were obtained and filter cloths clogged rapidly. The air was soon increased to 1.2 cu.ft. per gallon and the nitrate built up to 5 to 10 p.p.m. Coincidentally the sludge began to press more easily, and soon was back to its former satisfactory condition.

The present trend of development of the activated-sludge process seems to be in the direction of decreased aeration and minimum nitrification. Numerous mechanical and biological schemes are proposed which require less power than that required by aeration with compressed air, but generally no nitrification is obtained. The writer believes that thorough activation, as evidenced by formation of 5 p.p.m. or more of nitrate nitrogen, is essential for the production of a sludge that will filter easily,

Calumet Works—The Calumet works include two activated-sludge units, each with a capacity of 1.75 m.g.d. Sludge was built up and ready for pressing in June, 1923. An Oliver filter has been installed and has been filtering all sludge produced. This filter is 11½ ft. in diameter and 14 ft. long and is covered with 495 sq.ft. of filter cloth. It has not been possible to run for more than 7 or 8 hours continuuosly with this filter as the sewage is quite dilute and the sludge accumulates slowly. As at the Des Plaines works it was found that untreated sludge would not filter satisfactorily. Alum was used for preparation of the sludge, but it was found desirable to add more alum, up to 14 lb. per 1,000 gal. A number of tests with Buchner funnels indicates much more rapid filtration with alum treatment than with acidification. The filter has worked satisfactorily during the short time it has been operated. The average rate of filtration has been approximately 0.011 lb. of dry sludge per square foot of filtering surface per minute. This high rate of filtration, combined with the fact that filtration is continuous and cleanly, has indicated that this type of filter is preferable to the pressure filters at Des Plaines.

Corn Products Testing Station—An unusual type of activated sludge has been produced at the testing station treating the wastes from the Corn Products Refining Co., at Argo. This sludge is usually very light and voluminous, frequently containing over 99 per cent water. It contains more than 75 per cent organic matter on the dry basis, and from 6.5 to 7.5 per cent nitrogen. The problem of pressing this sludge is unusually difficult because of its watery nature and the rapid changes in its character due to biological conditions.

Two filters have been used for pressing this sludge, a recessed-plate filter press and a small American continuous filter. The latter is a rotating leaf suction filter containing 20 sq.ft. of filtering surface. In principle it is similar to the Oliver filter. Many substances have been used for pretreatment of the sludge before filtration. It was frequently found impossible in the winter of 1921-22 to produce a cake in the filter press, no matter what was the pretreatment.

The American filter has offered more hope. Sludge has been pressed both hot and cold many times, using, as filter aids, sulphuric acid, alum, di-calcium phosphate, spent bone ash, sulphur dioxide and filter-cel.

Conclusions—General conclusions are as follows:

1. By suitable pretreatment of the sludge it should be possible at all times to produce a cake with a type of suction filter similar to the American filter.

2. A very dilute sludge (99.5 per cent water) or one not well-activated cannot be pretreated with any of the above substances, including heating to 150 deg. F., so as to give a high rate of filtration (that is, a rate greater than 0.08 lb. per square foot per minute). A well-activated sludge with a moisture content of 98.5 or 99.0 per cent can be treated with either alum or acid, with or without heating, and will give a satisfactory cake with a high rate of filtration. The moisture content without heat is usually about 85 per cent, with heat from 80 to 82 per cent. Heating apparently does not materially increase the rate of filtration. Alum treatment is generally more effective than acidification.

3. Phosphates, bone ash, filter-cel and sulphur dioxide are of little value.

4. The ratio of time of pick-up to time of drying is fixed. It would be desirable to be able to vary the ratio, that is, to shorten the time of pick-up with a heavy sludge and to lengthen it with a dilute sludge. Control of the degree of vacuum or blanking off of one or more sectors are unsatisfactory methods for accomplishing such variations.

Flood Flows or Maximum Runoffs of Montana Streams

Tabular Data and Curves for Streams East of Divide, West of Divide and on Prairies, Based on Recorded Runoffs

By George Henry Ellis
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IN DETERMINING the required capacity of the waterway under a bridge, a highway or railway culvert, or the spillway of a dam, the best method is to be there when the greatest flood occurs and measure the discharge. If that has not been done, perhaps the next best method is to find some marks left by the highest flood, and make an estimate of quantities based on measurements of cross-section and slope. If this method, in turn, is impractical or uncertain, the drainage area

FLOOD FLOWS OR MAXIMUM RUNOFFS FOR THREE CLASSES OF MONTANA STREAMS

Mountain Streams East of the Divide:

Stream, Station and Period	Drainage Area, Sq.Mi.	Record Flood, Sec.-Ft.	Date		Second Feet Per Sq.Mi.
Beaverhead R. at Barratts 1907–22	2,870	3,640	June 19–20,	1908	1.27
Jefferson R. nr. Silverstar 1910–16; 1920–22	7,840	16,500	June 15,	1913	2.10
Missouri R. nr. Townsend 1891–01	16,400	52,500	June	1899	3.20
Missouri R. at Cascade 1902–15	18,300	49,300	June 5,	1908	2.69
Missouri R. at Fort Benton 1881–91; 1902–22	24,600	107,000	June 7,	1908	4.35
Madison R. nr. Norris 1897–05	2,085	10,300	June	1899	4.94
Gallatin R. (W) nr. Salesville 1895–05; 1910–13; 1921–22	860	10,750	June 18,	1896	12.5
Tenmile C. nr. Rimini 1915–22	33.9	984	May 15,	1917	27.9
Sun R. Nth. Fk, near Augusta 1889–90; 1903–21	596	32,300	June 21,	1916	54.2
Sun R. at Ft. Shaw 1912–22	1,475	17,500	June 22,	1916	11.9
Ford C. nr. Augusta 1906–12	19.7	720	June	1908	36.6
Marias R. nr. Shelby 1902–08; 1911–22	2,610	29,500	June 24,	1907	11.3
Birch C. at Swift Dam 1913–22	75	5,275	June 21,	1916	70.3
Yellowstone R. at Corwin Springs 1910–22	2,630	26,500	June 14-15,	1918	10.1
Yellowstone R. at Livingstone 1897–05	3,560	26,820	June	1897	7.53
Yellowstone R. at Huntley 1907–16	12,000	58,100	June 30,	1916	4.84
Yellowstone R. at Forsythe 1921–22	40,200	63,600	June 15,	1922	1.58
Yellowstone R. at Intake 1911–22	66,800	159,000	June 21,	1921	2.38
Big Horn R. nr Hardin 1904–22	20,700	40,800	June 17,	1908	1.97
St. Mary R. nr. Babb 1902–15	177	7,980	June 5,	1908	45.1
St. Mary R. blw. Swiftcurrent C. 1901–02; 1910–15	298	6,690	July 4,	1902	22.45
St. Mary R. nr. Int'l Bdry. 1902–22	472	18,000	June 5,	1908	38.2
Canyon C. nr. Many Glacier 1918–22	7.0	500 est.	May 16,	1922	71.4

Mountain Streams West of the Divide:

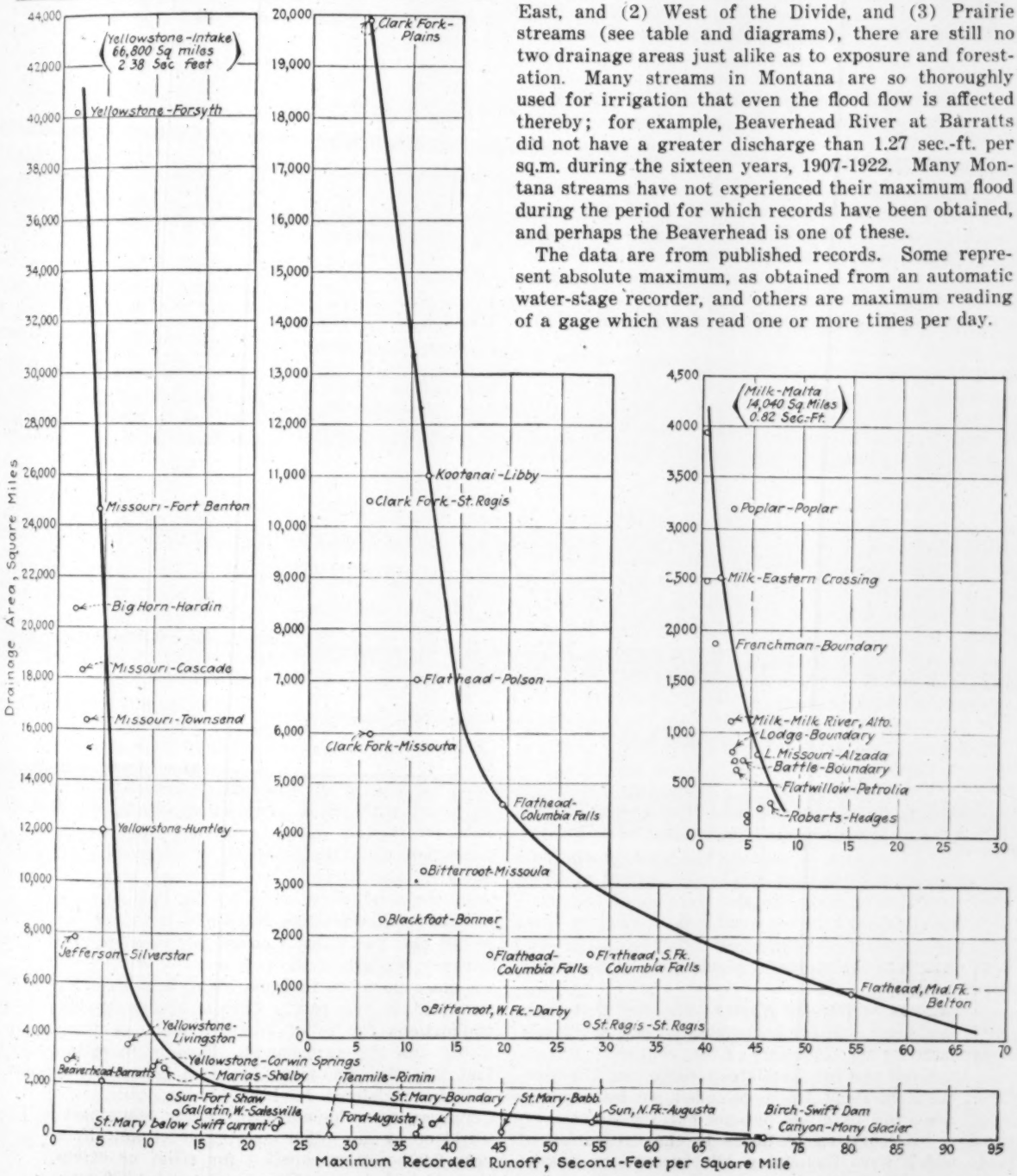
Kootenai R. at Libby 1910–22	11,000	130,000	June 21,	1916	11.8
Clark Fk R. at Missoula 1898–07	5,960	35,800	June	1899	6.01
Clark Fk R. at St. Regis 1910–22	10,500	62,800	May 30–31,	1913	5.98
Clark Fk R. nr. Plains 1910–22	19,900	115,000	June 5, and July 2,	1913 1916	5.78
Blackfoot R. at Bonner 1898–05	2,310	17,244	June	1899	7.47
Bitterroot R. W. Fk nr. Darby 1910–17	572	6,730	June 17,	1917	11.76
Bitterroot R. nr. Missoula 1898–01; 1903–04	3,260	37,437	June	1899	11.5
St. Regis R. nr. St. Regis 1910–17	278	7,740	May 28,	1917	27.85
Flathead R. nr. Columbia Falls 1910–17	1,620	29,500	June 20,	1916	18.2
Flathead R. at Columbia Falls 1922	4,560	88,200	June 5,	1922	19.3
Flathead R. nr. Polson 1907–22	7,010	75,400	June 13,	1913	10.75
Flathead R. N. Fk. at Belton 1910–22	900	49,000	June 21,	1916	54.44
Flathead R. S. Fk. nr. Columbia Falls 1910–16	1,640	46,200	June 19,	1916	28.2

Prairie Streams:					
Roberts C. at Hedgesville 1920–22	320	'2,290	June 17,	1921	7.16
Flatwillow C. at Petrolia 1921–22	649	2,400	June 6,	1922	3.70
Milk R. at E. C. 1913–22	2,514	4,860	Apr. 9,	1917	1.94
Milk R. at Malta 1902–22	14,040	11,500	Mar. 27,	1918	0.82
Milk R. at Milk River, Alberta 1909–22	1,104	3,467	Feb. 17,	1916	3.14
Lodge C. at Int'l Bdry. 1917–22	806	2,700	Mar. 31,	1918	3.35
Battle C. at Int'l Bdry. 1917–22	730	3,200	Apr. 13,	1917	4.39
Frenchman R. nr. Int'l Bdry. 1917–22	1,875	2,780	Apr. 30,	1917	1.48
Pig Muddy C. nr. Culbertson 1908–21	3,930	1,550	Mar. 31,	1916	0.40
Little Mo. R. nr. Alzada 1911–22	780	4,550	Apr. 6,	1912	5.84

tributary to the stream at the proposed structure may be measured and compared with some similar area for which the maximum flood is known. Data for use in the latter method on streams in Western United States, and in New York State, have recently been presented in these columns, and similar data for Montana are given herewith. (See *Engineering News-Record*, July 3, 1919, p. 28, article by John T. Whistler, and Nov. 4, 1920, p. 879, article by E. H. Sargent.)

In a country so varied as to climate and topography as Montana, considerable judgment must be used in basing estimates on data of this sort. Even after the data have been classified as to mountain streams (1) East, and (2) West of the Divide, and (3) Prairie streams (see table and diagrams), there are still no two drainage areas just alike as to exposure and forestation. Many streams in Montana are so thoroughly used for irrigation that even the flood flow is affected thereby; for example, Beaverhead River at Barratts did not have a greater discharge than 1.27 sec.-ft. per sq.m. during the sixteen years, 1907-1922. Many Montana streams have not experienced their maximum flood during the period for which records have been obtained, and perhaps the Beaverhead is one of these.

The data are from published records. Some represent absolute maximum, as obtained from an automatic water-stage recorder, and others are maximum reading of a gage which was read one or more times per day.



MAXIMUM FLOOD DISCHARGES OF MONTANA STREAMS EAST AND WEST OF DIVIDE AND ON PRAIRIES

Federal Land Reclamation: A National Problem

9. The Future of Federal Reclamation

The Ninth and Last of a Series of Articles on History and Performance of the Great Government Adventure in Irrigation of the Arid lands of the West

By HON. ADDISON T. SMITH

Chairman, Committee on Irrigation of Arid Lands, House of Representatives, U. S. Congress

THE 68TH CONGRESS, which has just assembled, has before it innumerable problems of national and international importance, many of which are of great interest to engineers as such, as well as from the standpoint of good citizenship. Among these questions, there is perhaps none more vitally important, as it relates to the stability of government and of business institutions, than that of the national policy of land reclamation and settlement. From the earliest times the land question has been recognized as fundamental in the stability of all government. In fact, one of the most difficult questions and one which threatened the existence of the nation as a whole was that growing out of the ownership and use of the vast tracts of land west of the original colonies; when the title to these lands was finally confirmed in the United States, then and not until then was the stability of the Union assured.

The necessity of using these public lands for homes for citizens was early appreciated, but the ways of assuring such best use were not finally agreed upon until the passage of the homestead act, which in effect dedicated to homemaking the greater part of the public lands of the country. The growth of the United States in population, industry and in everything that makes for good citizenship has been closely connected with the utilization of the vast extent of lands which could be employed in the creation of the small self-supporting farm homes—small in distinction from the great estates or ranches of other countries but large enough to absorb the available labor of the owner and his family.

Reclamation to Develop Homes—The fact that these public lands, suitable for home-making, had practically disappeared by the beginning of this century led Theodore Roosevelt and his associates to urge that the benefits of the Homestead Act be extended, not by annexing lands belonging to other nations but by internal expansion, by removing obstacles to the cultivation of lands which were then lying idle because of lack of water. In his first message to Congress, December, 1901, Roosevelt urged that the public lands of the arid region be reclaimed so that homesteading might continue. Under the stimulus of his personal interest in the matter and with the active efforts of many notable statesmen the Reclamation Act finally became a law, being signed by President Roosevelt on June 17 (Bunker Hill Day), 1902.

Two decades and more have elapsed since that time. The vacant public lands so far as these may be irrigated or reclaimed have practically all disappeared. Although about 190,000,000 acres of vacant public lands remain on the tract books of the Land Office, practically all of these consist of rejected areas—of mountains, plateaus or rock-strewn valleys, and lands where the soil is too thin for cultivation. Every valley in the arid region has been explored, every piece of land which under any conceivable plan may ultimately be utilized is gone, so far as government reclamation is concerned.

The extraordinary and unlooked-for success of the Reclamation Act has resulted in a great stimulus of enterprise in the arid region as a whole, and to an extent such as to force land prices so high, as compared with recent crop values, as to render further reclamation plans a matter for serious consideration from the financial or economic standpoint. Many of the projects now proposed may cost more than the productive value of the land.

Is More Reclamation Needed?—It is not to be inferred that the West is completely developed. On the contrary, we are at the beginning of development, but we must go at it in some other way than has been practiced in the past. This is shown by the many applications for relief from payment of the installments due the government. This is in spite of the fact that the conditions for such payment for water for the reclaimed land have been made, by act of Congress, more lenient than in any other part of the world or by any other country or organization. Last year 2,000 settlers applied for relief or extension of time of payment, and this year over 4,500 are urging

Congressman Addison T. Smith on Future Reclamation Problems

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A self-supporting home established in the East is as important to the nation as one in the West.

The existence of public lands should not be made the prerequisite for the continuation of the national policy of home-making. On the contrary, this policy should be adapted to present conditions of land ownership.

The formation of reclamation districts under state law is one of the large steps in advance. We must go back to the original conception, that if the government initiates the work and puts it on its feet there must be some organization or district acting under state law which must take up the petty details of dealing with the individuals.

The federal government is furnishing all the money, doing all the work, is being criticized because it does not enter into more details, while the state is doing little or nothing in the way of solving the problems of its citizens on the reclaimed lands.

some concession. Many of these claims are doubtless meritorious, but the fact that so many are making application indicates that there must be some change in present methods.

It should not be assumed that the West, which has contained such vast areas of public land, is the only undeveloped portion of the United States. The country as a whole, as concerns its continued growth and prosperity, cannot confine its efforts to any one section. A self-supporting home established in the East is as important to the nation as one in the West. It is the contented and prosperous home which should be considered, not the particular locality of that home.

This important consideration that the nation is concerned, not with the reclamation of public land because it is public land, but with the ultimate object of home-making gives a broad view of the situation. It forces us to consider the opportunities offered in every part of the country. For many years the people of the South have been insistent that so far as national and business stability are concerned it is the unused land of the South which should have early consideration. They have claimed that with the rapid development of the West, the South now presents more opportunities. There are no public lands remaining in the South. The existence of public lands should not be made the prerequisite for the continuation of the national policy of home-making. On the contrary, this policy should be adapted to present conditions of land ownership and be so modified as to encourage the settlement of vast tracts of land suitable for homemaking.

Opportunities In the South—There is no doubt but that the success of reclamation in the West has stimulated other parts of the country to demand that equal consideration be given to their claims. It is a matter of history that when the Reclamation Act was under consideration the South voted to help the West and with the understanding that, if the time should come that the South was in a position to need similar legislation, the western men would come to its aid. The time has now arrived when the people of the South are demanding such consideration and are pointing to the fact that if the ultimate object of the Reclamation Act is the making of homes, then, under present conditions, homes can be made in the South as well as in the West.

To put it in another way, the success of national reclamation in the arid region has stimulated interest and enthusiasm in the underlying ideals of home-making, and if the West is to continue with federal assistance it must share this with other parts of the country. It can no longer stand alone or claim the unique distinction of having public land to be reclaimed in any considerable tracts.

This claim for general consideration is by no means new. Congress has already recognized that something should be done; in 1918 it appropriated $100,000 for a study of the unused lands in every state. The report, printed in 1919, illustrates the fact that there are lands available in every section of the country, many of which may be utilized as need arises. It is true that these lands are in private ownership, individual or corporate, but they can be obtained on terms not much more onerous than those attached to public lands. The owners of many of these tracts, seeing the hopelessness of financial gain in the reclamation and settlement of these lands, have offered to turn over these areas to bona fide settlers at rates which may be approved by competent authority as being fair.

It is possible to conceive of a land reclamation and settlement district, organized under the state law, embracing suitable lands and conducted in such way as to give reasonable assurance to home-seekers that they will have a square deal. It is also possible to conceive that the financing of such districts may be done under federal auspices in such way as will ultimately recover the investment, although the interest may be lost to the government during the years of pioneering. Compensation for this loss of interest is more than made up by the fact of the ultimate settlement of the land, and the making of self-supporting homes. It is recognized that, in every undertaking of this kind, some aid must be given; the most effective way is through this forfeiting of interest on the investment during these early stages.

Improvement of Existing Laws—The Reclamation Law as it now stands is applicable only to lands in the sixteen arid or semi-arid western states, Kansas to California, Montana to Arizona. It has been amended from time to time in certain details, particularly those having to do with the repayment of the amount owed to the government on account of the capital investment in irrigation and drainage works. The result is that the law as a whole is more or less of a patchwork; it is somewhat inconsistent in its details and requires for effective application many fine-drawn distinctions or inferences which should be covered by explicit statement of principles. In short, the methods of administration forced by the necessities of the case are not embodied in the law but are permissible by inferences drawn from apparent intent of the act, rather than from direct authorization.

This latitude of the reclamation law was very desirable and even essential twenty years ago, when conditions were almost unknown, but now that federal reclamation has become an established fact, it is the part of wisdom for Congress to recognize the larger needs and to place responsibilities more definitely than in the past.

Reclamation Districts—The formation of reclamation districts under stated law is one of the large steps in the carrying out of the objects of the Reclamation Act. These districts should be encouraged or even compelled to take a larger responsibility in the administration of affairs, not leaving the land owners and their tenants to shift the burdens of operation and maintenance to the shoulders of Uncle Sam. The Reclamation Act in its very essence requires that large responsibility be assumed by the federal department or bureau having the matter in charge, but the duties have been greatly increased by this strongly marked tendency to force good-natured Uncle Sam to carry the burden longer and to a larger extent than was contemplated originally.

Under the Act of 1902, it was assumed that payments would be made without interest during the pioneer period of ten years, and that before this time had elapsed the local people would have assumed full responsibility and control. Congress extended the time to twenty years, but made no requirements such as to facilitate the government's laying down the burden. Recently, a provision was inserted in one of the Appropriation Acts which may require the government, in connection with the Milk River project, in Montana, to keep control and practically peddle out water for fifty

years. It is thus forced to interfere in the local affairs of water distribution to small communities, a condition which tends toward continued misunderstanding and exasperation. We must get over this and go back more nearly to the original conception, that if the government initiates the work and puts it on its feet there must be some organization or district acting under state law which must take up the petty details of dealing with the individuals.

Extension of Time—In connection with the operation of the Reclamation Act there is no one thing which has taken up so much time of Congress and in its committees and has led to such exasperation on the part of its members as the steadily increasing demand for extension of time of payment. At the end of the first ten years, Congress concluded that a ten-year period for payment of the capital invested in the water which made the farm available was too short, even though this payment was made without interest. After considerable discussion it was concluded to grant *terms so easy that under no possible condition could any landowner fail to make good*; that is to say, to make the installments on the capital invested less than the ordinary payment of interest.

For example, the government may have invested $80 per acre in the reclamation of land. This land was given away originally under condition of settlement. The man getting this piece of land was required to pay this $80 for the water in installments without interest, extending over a period of twenty years. To put it in another way, if the landowner paid 5 per cent a year for twenty years, he could have the water for nothing. More than this, to cover the pioneer period, it was provided that for the first four years the landowner need pay only 2 per cent installments, then for the fifth and sixth years only 4 per cent installments, and for the remaining fourteen years 6 per cent, all of these without interest on the deferred amount. Here were terms far easier than those offered by any country or community and Congress gave a sigh of relief that the whole thing was settled and for all time. Many members thought this too easy, and urged that at least a small interest charge should be demanded, and conditions after the first ten years made comparable to those of the Federal Farm Loan banks.

Now, however, after a few years of payment of the installments on the capital invested of 2 per cent, thousands of landowners plead that they cannot keep up this rate of installments. Last year 2,000 appealed for relief, this year over twice as many. There is no doubt but that many of the settlers do need help, on account of excessive cost of the project, poor soil, small yield and the like, but those unfriendly to the reclamation policy argue that the beneficiaries under the Reclamation Act should be required to meet their payments or accept terms comparable to those of the Federal Farm Loan Act, amortizing the debt in from 30 to 40 years but with payment of a small interest, equivalent to the amount the taxpayers are carrying on money borrowed by the government.

The annual relief bills will probably come before Congress as long as there remains any debt to the United States, unless some general rule should be laid down consistent with sound business principles, and the commissioner of the Reclamation Service or a board given the power and duty to establish regulations for adjustment of payments after a thorough investigation has been made of the necessities of the settlers on the different projects and to see that these regulations are carried out in a spirit of fairness.

Co-operation Between State and Nation—One of the chief criticisms of the Reclamation Act is that it is too one-sided. The federal government is furnishing all the money, doing all the work, is being criticized because it does not enter into more details, while the state is doing little or nothing in the way of solving the problems of its citizens on the reclaimed lands.

Undoubtedly there will be better appreciation of the work done by the government if much of this is made contingent upon the performance of equally important functions which fall within the state jurisdiction. The selection of settlers, getting the reclamation lands into the hands of men who will actually use them, providing advice toward better crop production—all of such work and many other details should be handled to a larger extent by the state or state organizations, farm bureaus, and others. The national government should be in a position to deal with the state or municipality organized under state laws and not be put in the position of supervising the details of water distribution to thousands of farms.

In particular, the financing of the settler is a matter which should be taken up by the state. Under present conditions, the landowners must borrow considerable sums of money, on which they are paying 8, 10 and 12 per cent, a rate which it is impossible to continue for any considerable time without injury. There are many arguments why, if the federal government will provide the water, the state or its subdivisions should give proper attention to these financial needs.

Taxes—In addition to the heavy interest charges for which relief should be offered, there are the steadily increasing taxes which are piled on the back-breaking load of the irrigator. Remember that the greater part of the taxes is of local origin, state and county. These taxes are under local control and yet they have increased with such rapidity that many an otherwise well-to-do farmer has been compelled to give up, the taxes representing a proper margin of profit.

The reason for this heavy taxation is evident in that on the reclaimed areas the people in the towns especially have demanded the conveniences of a highly settled community. They are building roads, bridges, schools and public buildings surpassing those of communities which have been settled for a hundred years. They are trying to pay for these things in a few years. All of them are desirable, some are necessary; but more necessary is it to keep the taxes within the limits where they can be paid.

A Vision of the Future—In what I have written I have tried to point out the things which should be done, and it might be inferred that, because I have pointed these things out, they are the large features of reclamation. On the contrary, while important they are not the whole story. I have not taken time to amplify upon the advantages and the great opportunities which lie before us in the future. I am merely pointing out the bad places in the road. At the same time the road does lead through pleasant valleys and has great attractions. It leads to far better conditions than I have touched upon. We are only at the beginning of land reclamation. We will realize even more largely than in the past the vision of the men who work for reclamation and the making of farm homes. We will ulti-

mately achieve these but we can do so more quickly and more satisfactorily to all concerned if we consider the rough spots and smooth them out.

The country as a whole not only needs more opportunities for homes but can provide these opportunities to be taken up in an orderly manner as needed, when we make use of the experience we have had in the last twenty years. By utilizing that experience and by doing some of the things which I have described, we will be performing not only a necessary duty but one which will redound to the peace and prosperity of the whole nation.

Dining-Car Train Serves Mid-Shift Meal to Tunnel Crew

TWO OF THE headings on the 13-mile Florence Lake tunnel, which is being constructed by the Southern California Edison Co. on the Big Creek project are now two miles underground. Because of the distance from the portal camps a great deal of time would be lost in taking the tunnel crews out to their mid-shift meal. Moreover, from the point of view of the workmen there is serious objection in the winter time to the long ride and cold outside air, without time for a shower which they would take when coming off duty, thus both the crews and the company are highly pleased with a plan recently put in effect whereby the tunnel crews are supplied with a hot mid-shift meal served in the tunnel near the heading.

This plan has been made possible by the construction of dining-car trains, one of which is shown in the accompanying picture. This train is composed of five cars, three of which are equipped with tables and benches as shown, the other two being designed to carry the food into the tunnel and for use there as serving tables.

The food is transported in containers originally built for army use, which utilize the fireless-cooker prin-

MESS TIME IN FLORENCE LAKE TUNNEL

ciple in keeping the food hot in transit. Two waiters accompany each train, make the "set-up" prior to the meal, replenish the dishes and afterward clear up and return the utensils to the cook house at the portal camp.

Each dining-car train is handled by an extra locomotive so as not to interfere, in any way, with the mucking operations. Needless to say the inbound dining-car train does not meet with delay en route if the tunnel crew can prevent it. Under present conditions it would take a minimum of 1½ hrs. to bring out the crew, give them time to eat and return them to their work. This time, of course, would increase as the heading is advanced. The new arrangement takes the men away from their work only for the length of time required to eat. The plan was put into effect in November and was very popular with the workmen from the outset, as now they do not have to come out into the cold air until they can go direct to their bunk houses.

Construction methods on the Florence Lake tunnel were described in *Engineering News-Record*, May 3, 1923, p. 776. The work is being done by force account under the direction of D. H. Redinger, resident engineer, for the Southern California Edison Co.

Ballast Sections on French Railways

AN INCREASED depth of ballast has been adopted on several of the French railway systems as a result of the greater weight of modern locomotives and rolling stock. This change is noted in the *Revue Generale des Chemins de Fer* by M Descubes, maintenance engineer of the Eastern Ry., and it is pointed out that the engine loads do not reach those of American railways. Formerly the depth under the tie was about 9 in. on straight track (sometimes only 7½ in.) and 6½ in. to 7 in. under the lower ends of the ties on curves.

In the new roadbed and ballast section of the State Rys. the ballast depth is 10 in. under the ties or 15.6 in. from top of tie. This is also the minimum depth under the low rail on curves. On double track the depth is 14.6 in. at the crown or middle of roadbed and 18 in. at the shoulders. The Southern Ry. uses an 8-in. bed of sub-ballast and a minimum of 7.3 in. of ballast proper. A similar construction on the Eastern Ry. has 8- and 6½-in. depths respectively. In all cases the ballast is level with the tops of the ties and has a shoulder 32 in. to 36 in. outside of the rail. Formerly this distance was 39 in. to 48 in., with a view to affording lateral support to the track, but it is now considered that the value of such a shoulder is relatively small. Where a bottom course of sub-ballast is used, it sometimes extends the full width of roadbed and forms side berms outside the ballast proper.

A conference of engineers of maintenance-of-way in August, 1923, adopted conclusions which are summarized below:

1. A thickness of ballast sufficient to distribute the load uniformly over the roadbed will avoid maintenance work on operated lines the cost of which work would be out of all proportion to the slight saving by using less ballast. On new roadbed the thickness of ballast and sub-ballast should be at least 14 in. under the tie at the rail. This depth may be reduced when the roadbed material is both stable and permeable, but on irregular rocky roadbed it should be increased, since a good cushion of ballast will reduce rail breakages. On an old roadbed, compacted and drained, a thickness of 10 in. under the ties may be sufficient.

2. A width of 32 in. from rail to shoulder of ballast is sufficient, but may be made 39 in. on new lines to provide a reserve of ballast in surfacing.

3. The ballast proper should be at least 6 in. deep under the ties. Sub-ballast should be of a finer material but sufficiently permeable for drainage.

4. Transverse crowning of the roadbed with grades of 0.3 to 0.5 per cent is advisable for drainage. On curves, the summit or high point may be placed under the outer track to avoid excessive depth of ballast.

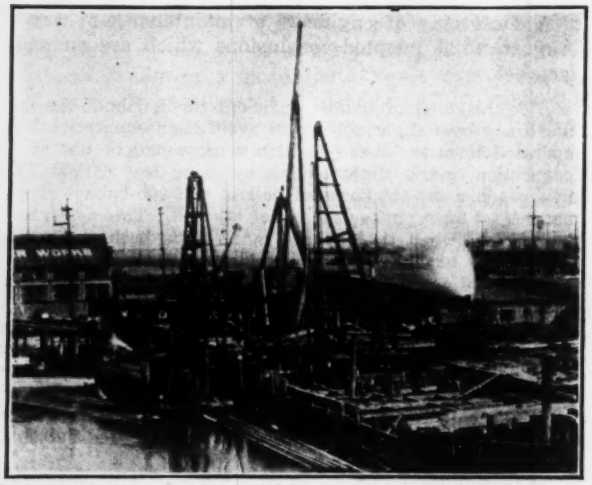
Deep Water Pile Driving for Seattle Bridge Piers

Good Progress Made on Pile Foundations for Spokane Street Bridge—Convenient Form of Follower Head Saves Time

THE CITY of Seattle now has under construction the Spokane St. crossing of the West Waterway which will be a bridge for vehicular and electric railway traffic, having for its central span a 288-ft., double-leaf bascule. Despite the depth of water around the piers for this central span, which required the use of an unusually long follower, good speed was made in driving the piles. In an ordinary eight-hour shift 20 piles or 1,700 lin.ft. of piling were driven using piledriver leads much shorter than the average length of the piles themselves. Piles were driven through silt to hard bottom 130 ft. below mean high water.

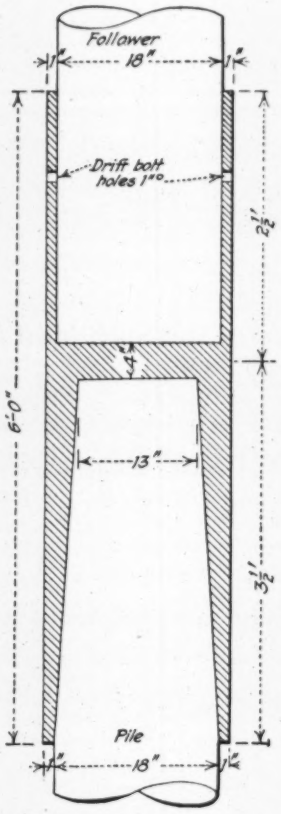
The order of procedure found most satisfactory was as follows: A derrick with a 90-ft. boom picked up the piles, which averaged about 85 ft. in length, and delivered them to a skid-rigged driver. Before taking the pile the driving crew put down between the driver leads a jet consisting of a 5-in. pipe, 100 ft. in length, in which a pressure of 250 to 300 lb. was used. This pipe was put down for each pile, first to the full depth and then thrust down three or four times to depths of about 40 ft. The bottom was hard enough to shut off the water pressure abruptly, making further jetting impracticable. Ordinarily this operation required about 3 or 4 minutes for the first long thrust and about one minute each for the thrusts to a lesser depth, and carried the top of the 100-ft. pipe as much as 30 ft. below the top of the cofferdam shown in the illustration.

The jet was slung from a block attached on one side of the leads near the top so that, as soon as the pipe was lifted and the guy line holding it between the leads was slacked off, it would swing out of the way of the pile which would then be put in the leads as quickly as possible so as to get it down in the jetted hole before there was time for the hole to fill up. The pile was simply centered in the leads and dropped; about 90 per cent of the time piles handled in this way went down into the jetted hole until supported by their own buoyancy, that is, the pile would float upright in the hole made by the jet and would remain with 15 to 20 ft. of its upper end projecting above water level. The cofferdam had been excavated to a depth of 53 ft. below mean high water.



DRIVING LONG PILES WITH A FOLLOWER

The derrick boom is ready to deliver pile to the driver on the right from whose leads the jet pipe is being removed. The driver at the left is used only to pump water for jetting.



ELEVATION THROUGH CAST-IRON FOLLOWER HEAD

By using a cast-iron head of the type shown in the accompanying sketch no time was required in centering the head on the pile because of the taper section in which the specially prepared heads of the piles would center themselves. The pile heads were all axed off while drawn up on the deck of the floating driver by a boom-man and helper, this axing giving the pile head a taper corresponding with the taper in the iron head.

The head shown in the sketch was attached to a selected 18-in. fir follower, about 60 ft. long, to which it was fastened by four 1-in. bolts driven into the follower through holes in the casting. The follower with the head attached was put on the pile immediately after the latter stopped sinking of its own weight. The weight of the follower caused it to sink still lower, in fact always low enough so that the hammer could be placed upon the follower. In driving 560 piles there were only two cases where the head stuck to the pile.

The hammer was a 4,500-lb. drop hammer. This was ordinarily used about ten minutes on each pile with blows varying from 8 to 10 ft., which was sufficient to give the 85-ft. piles a penetration of 50 to 60 ft. in addition to the depth they had sunk in the jetted hole.

The floating driver was used only on account of its pump equipment which supplied water for the jet. The derrick was so placed that it could pick up a pile and place it vertically alongside the driver leads where it would hang until the jet pipe was removed and the pile could be swung into the leads. After delivering a pile to the driver the derrick picked up the follower and held it suspended ready to place in the leads on the pile. This saved time.

The driving crew consisted of one foreman, one stationary engineer on driver, one stationary engineer on pump, one boom-man and helper preparing pile heads, three loftsmen, one man on winch handling line—a total of nine.

The work was done by the J. A. McEachern Co., contractors, J. A. McEachern, president, and B. F. Cook, general superintendent. The project as a whole is under the direction of J. D. Blackwell, city engineer. A. Münster is bridge engineer for the city and E. K. Triol is supervising engineer in charge of construction for the city.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

THIS is the twelfth and last of the series of letters written by Mr. Schmitt during a journey recently made through the West in which he visited irrigation projects, studied developments, and interviewed builders, operators and settlers, in order to present to our readers the actualities of reclamation as revealed to an unprejudiced investigator.

Chicago

MANY illuminating opinions on irrigation and reclamation were expressed in the course of the interviews I have had during the last two months in the irrigation country. They are the views of men who have lived in contact with irrigation farming and its successes and troubles for many years, and who have seen the endless promotion, mismanagement and confusion of private irrigation work as well as the much troubled development of federal work. Moreover, these men are familiar with the farmer's problems and his psychology.

Because the opinions expressed in these interviews give an excellent perspective of the irrigation situation, a selection of citations from them will help the engineering reader in appraising the present reclamation situation. Names are omitted.

Success in reclamation farming comes to the same kind of people that would succeed on other farms; and in ordinary farming there are always many failures. I can't see how the weeding-out process is ever going to be avoided in reclamation. The successful farmer can pay the construction charges, the others can't.—*Grand Valley farmer.*

The statement that it takes from two to three crops of settlers to make an irrigation project a success is specially true of private projects. All have been failures, in some cases again and again. The few exceptions were cases that had the best land and the simplest and cheapest water supply.—*Former state engineer.*

The Congressional relief acts did not work well here. Many people applied for relief who could pay but thought they would never have to.—*Project manager.*

Eighty per cent of the settlers here weren't farmers, and these are mostly gone. The other 20 per cent, the farmers, are still here.—*Water users' official.*

I believe the Reclamation Service never took the trouble to see that in starting up an irrigation project there lay problems that it was their obligation to solve even at the cost of stirring up Congress to improved legislation and a change of system.—*Engineer farmer.*

Farm debts are probably in good part due to inflation and deflation, but in part to the farmer's inability to make his farm pay. The men that came here were the skimmings of farming and other communities. As the records show, it was largely the failures in business elsewhere that came to try farming on this project. There is some real sentiment that the farmers should not pay the construction charge, but most of the protest sentiment is created or magnified by political agitators.—*County attorney.*

A large part of the farmers' difficulties here is due to speculation in sheep and land, and some in oil, during the war boom of prices. Those who took their crop money to pay their debts are not grumbling now.—*Project manager.*

Probably no other region of the same size in this valley is as good as ours in soil. Yet last year we had to sell 120 tax titles, and this year we will sell 20 more, and probably few of these will be redeemed. They include some of the best land on the project here.—*Water users' board member.*

Outside of not enough water in July, our trouble is lack of capital, inexperienced farmers and high freight rates. In shipping our produce we are like the last man on the ditch.—*Chamber of Commerce manager.*

The reclamation projects are *not* failures in agricultural productiveness. They are well located, have a good water supply, and are operated economically. But in constructing them the government created an increment of value, and by putting no bar to transfers it encouraged land speculation. That is the root trouble.—*Private project manager.*

People in irrigation regions are enthusiastic about irrigation when they haven't got it and want money to provide it. Afterwards they complain. At Yakima farmers on private ditches pay $10 per acre, those on the government projects $2 to $3, but the latter protest while the former pay. The settlers' attitude toward their obligations is an essential element in the whole problem.—*Irrigation engineer.*

Water users might operate more cheaply than the government, through eliminating the overhead of the outside offices. But if any emergency happened, the water users might not have the means to handle it. This makes government operation safer for us.—*Umatilla farmer.*

All talk about the condition of the farmer is largely an outburst of something that has been seething for a long time. The price unbalance is at the root of it.—*Banker.*

The engineers on this project were learners, and naturally they had to cover up their mistakes. At that time and later the farmers had the difficulty of not being able to reach the higher ups.—*Newlands farmer.*

A man who gets right down in the dirt and roots can't fail to make a success in irrigation farming here.—*Another Newlands farmer.*

From my experience in private irrigation and on this project I would say that people here are the same as elsewhere except that they lack the habit of self-help. The government has given so much relief that whenever anything happens they look to the Reclamation Service to help them out and take care of them.—*Irrigation superintendent.*

We have many kickers, usually kicking about nonsensical things. One fellow objects to drainage construction, and wants the river excavated to do away with flood dangers. We also have farming failures and these must be weeded out. There is no way of avoiding or shortening this process. But even apart from this, we still have far to go; we need more dairying, more poultry, and more truck farming, and we need farmers who like and understand these branches.—*Southwestern merchant farmer.*

The experiment station and the project office teach the doctrine of cow dung, elbow grease and butter fat. Alfalfa is worth twice as much when fed here as when shipped out. Every farmer who has good cows, tends to them decently and understands them, is getting along and is paying his bills.—*Project manager.*

Our project is a thorough success, taken altogether. But we have howlers, some because they are failures and others because they are such by temperament; none of them has constructive ideas. I doubt whether the unsuccessful farmer can be helped by advice or guidance. The chief trouble is that our people are not high-grade enough. We need more of the spirit of self-help and the spirit of co-operation.—*Southern banker.*

When the Reclamation Service warned the farmers on this project of the need for drainage, the warnings were not believed, and the farmers took no action for several years. Their losses from this neglect exceed the total construction cost of the project. But some farmers now want to blame the Service for not cramming drainage down their throats.—*Water users' official.*

The Federal Land Bank discriminates against project lands. It will loan on private irrigation land but refuses to loan on a federal project close by.—*Project manager.*

We are afraid that the project farmers have become

imbued with the idea that there is no need of paying the water charges, as they have always been able to secure extensions and deferments.—*Land Bank official.*

The reclamation farmer is too heavily burdened with debt. His average debt per acre is equal to or greater than the annual production; it should not exceed half this amount. The debts are not due to pioneering, but to speculative buying. Further, the farm regions have gone too fast with public improvements, which makes bonds and taxes too high. But farm land values are apt to ignore both the government equity and the tax rate. As to the farmer's attitude toward his obligations, and its effect on his credit, the facts speak clearly enough; the desire to evade obligations is there, and it weighs in the granting of loans. Aside from this factor, debt and inflation conditions are nearly the same in other recently developed agricultural districts.—*Federal Land Bank official.*

In considering applications from reclamation projects we apply just the same rules of sound appraisal as to private irrigation land. Due weight is given to the moral hazard. The bank is apt to regard the reclamation farmer as a less desirable borrower than an irrigation district farmer, because of the former's persistent attitude of disregarding his contractual obligations.—*Land Bank appraiser.*

The ones that don't pay and want relief are those who aren't good farmers.—*U. S. Senator.*

Perhaps 25 to 30 per cent of all our farmers are kickers, but most of these also are heavily in debt and are not succeeding. When they get out of debt they reform.—*Irrigation manager.*

Farming, like any business, requires some capital to start. Neither now nor never can the farmer get any other start than through his own effort.—*Banker.*

The man who has only $1,000 shouldn't expect to come here and make a go of it. This irrigation farming is not a poor man's game.—*Banker.*

Liquid financing is absolutely insufficiently provided for.—*Water users' official.*

Any farmer in sound condition and really in need of working credit can come in here and get all he wants.—*Banker.*

I don't believe you can select the good farmer at the start; but you can tell him by the results after three years, and then the government should weed out the unsuccessful ones by foreclosing the lien.—*Water users' official.*

Some years ago much land here in the Northwest was sold to clerks who thought they needed only to tickle the soil to become rich. When they found that they had to work two or three years they gave up.—*Washington engineer.*

Irrigation is often pure exploitation of people who have become obsessed with the back-to-the-land idea. Managers of irrigation developments either should keep out the unfit or they should teach them. These Carey Act projects, in particular, have even a more miscellaneous lot of people than government projects. One of the greatest hardships is the lack of a home at the start, with the result of throwing an excess burden on the wife; possibly half of the people who pulled out of here did so because the wife became discouraged.—*Idaho engineer.*

The Carey Act system appears to have failed. Successful for a short time, it was soon made speculative, and inadequate preliminary study of water, soil and cost became general. There are only one or two successful Carey Act projects. Fundamentally, it is the best system for reclaiming *raw desert*. The district system is good for operating, or for rehabilitating an area already settled.—*Oregon engineer.*

The federal reclamation enterprise is partly responsible for the failure of private irrigation. It gave a general boom to irrigation, which led to unhealthy conditions, failure to study water supply carefully, easy marketing of bonds, and the like, with disappointing results, which led to financial collapse. In other cases the difficulty of raising funds led to the hiring of low-priced engineers, which in turn resulted in dam failures and other ruinous results. It might have been better to let irrigation work out by evolution rather than to develop new areas under the impulse of federal reclamation.—*Colorado engineer.*

In one respect we enjoy an advantage over the government projects. We are not hampered by politicians. If the government doesn't eliminate this trouble and settle down to a fixed practice, all irrigation will suffer. We close out the failures promptly. The government can do the same thing; and it would, if it were left alone by the Secretary.—*Private project manager.*

Most of the farmers here are satisfied with ordinary crop yields. They overlook the fact that high production is necessary if they are to clear their obligations.—*Nebraska engineer.*

Where land before irrigation is worth only say $15, the attempt to bond it under an irrigation district for $60 to provide irrigation is questionable. The process involves the assumption that the land will be benefited correspondingly. Security for the bonds does not exist to begin with, and may not exist even after the loan has been made and expended. Yet this is widely done.—*Oregon engineer.*

The advocates of the $350,000,000 reclamation plan with forty-year repayment and 5½ per cent interest will have to hunt up much better projects than the present ones if they want them to pay out.—*Project manager.*

A fatal error is embodied in the reclamation system: charging the farmer no interest on the construction cost, which removes all incentive to pay when he has money available.—*Former state engineer.*

Two serious mistakes of past reclamation practice were that the government allowed entry on land before water was available, and that it dealt direct with the individual.—*Congressman.*

The reclamation policy as relieved by the twenty-year amendment and the extension act has worked out very well. The only matter in which its administration has been a little remiss is colonization and attention to the farmer. Thirty-year payment at the discretion of the management should be authorized, with interest at say 4 per cent. It may be necessary to write off some losses; but we should not put any permanent government investment into irrigation, for that would pauperize the farmer.—*Washington engineer.*

There is no room for a middleman between the water and the farmer.—*Mid-West Senator.*

It is the government's business to increase the water supply of the arid regions, but it is not the government's business to operate irrigation systems.—*Agricultural engineer.*

I see no way to cut government red tape in such work as operation of reclamation projects.—*California engineer.*

The reclamation fund was raised from Western lands and belongs to the West. We've got the reclamation fund, and you birds down East just try to get it away from us!—*State official.*

Two essentials of a reclamation policy are projects that will enable the average farmer to make a decent living when the costs are paid, and protection of the original owner from the temptation to borrow money at high rates and to sell for speculative profit.—*California engineer.*

Our people have cussed the government a lot, but at the same time when they sit down and think things over, they know it is all right.—*Yuma farmer.*

One fault in the original reclamation law was that it is not fair to private irrigation. The law should have provided for construction of storage only, leaving distribution to private initiative. It should have provided for interest payment, to be fair to private irrigation. It should have required selection of settlers for available capital, farming experience, attitude of wife, and the like. And the law should have put more freedom of action into the hands of the secretary. As to financing the settler, I see no ready way of doing it through the federal government. Development of the projects would be best handled by state settlement and state financing.—*Agricultural engineer.*

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Concrete Ships

REVIEWED BY S. C. HOLLISTER
Consulting Engineer, Philadelphia, Pa.

SEAGOING AND OTHER CONCRETE SHIPS—By N. K. Fougner, C. E., M. Am. Soc. C. E., Medlem Norsk Ingenieur Forening, Assoc. Inst. N. A. London: Henry Frowde and Hodder & Stoughton. New York: Oxford University Press, American branch. Cloth, 6x10 in.; pp. 216; halftones and line cuts. 22s.; American price, $7.

This constitutes the first important book on the single subject of concrete ship construction. It comes from the pen of an engineer who has been actively engaged in this type of construction for more than a decade, and who enjoys the distinction of being the builder of the first seagoing concrete ship, the "M. S. Namsenfjord."

The book, while it relates the progressive experiences of the author's work, is especially valuable in that it discusses frankly the advantages and disadvantages of concrete ships and minor service craft in commercial competition with wood and steel vessels. It is significant that in the world at large the concrete ship was not a product of the World War, but rather that its beginning was rooted in the peace time prior thereto. Whereas the war greatly stimulated the building of large cargo carriers, the post-war reduction in shipping together with the over production of vessels will probably prevent, in this country at least, the thorough operating trial that this type of vessel would receive in time of normal shipping. It is quite likely that the commercial aspect of the concrete ship will be determined earlier in Europe than in this country, because private interest in it there is more general, and because it was being seriously developed in time of peace. The book gives ample evidence of the two outstanding facts that concrete ships can be built on a commercial basis, and that they are seaworthy.

The author goes into considerable detail concerning the design and construction of vessels built by him, and summarizes, also, the design and construction of the U. S. Shipping Board's concrete ships. He presents many data on the properties of concrete, pertinent to ship construction, including the use of special lightweight aggregates.

Considerable discussion is also presented to show that the author has achieved in his construction vessels whose ratio of unloaded weight was less per ton of cargo than those built by the U. S. Shipping Board. It should be borne in mind that the latter vessels were designed to carry from three to six times the cargo of the largest of the author's vessels; and that no concrete ships of anything like their size had been built prior to their undertaking. There is little doubt that, had the program been continued, considerable economies in weight could have been effected as experience was acquired from the earlier vessels. Within certain limits, pioneer engineering in any line sacrifices economy in the interest of assured safety, and economy will only come as a refinement gained through experience.

There is presented a very interesting discussion of barges and lighters, together with well-established conclusions as to the advantages and economy of concrete craft of this class.

It is hoped that this book will outlive the present shipping situation in this country, to the end that its justified usefulness will be constructively available to those who are bound at some future time to continue the development of concrete craft. Certainly in those countries where the shipping is again finding itself, the book will present much of importance in developing in a sound commercial way the building and use of concrete ships of moderate size.

Earth, Sun, Climate and Civilization

REVIEWED BY X. H. GOODNOUGH
Chief Engineer, Massachusetts State Board of Health, Boston

THE EARTH AND THE SUN: An Hypothesis of Weather and Sunspots—By Ellsworth Huntington, Research Associate in Geography in Yale University. New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; line cuts. $3.50.

CIVILIZATION AND CLIMATE—By Ellsworth Huntington, Author of "The Pulse of Asia." [Second Edition, with New Introduction.] New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 333; line cuts. $3.50.

CLIMATIC CHANGES: THEIR NATURE AND CAUSES—By Ellsworth Huntington, Research Associate in Geography in Yale University, and Stephen Sargent Visher, Associate Professor of Geology in Indiana University. New Haven: Yale University Press. London: Humphrey Milford-Oxford University Press. Cloth; 6x9 in.; pp. 329; 13 line cuts. $3.50.

Earth and Sun, is a companion volume to the author's earlier Climatic Changes and should be read in conjunction with it in order that the general discussions and data presented may be intelligently followed. In Earth and Sun, the author illustrates very clearly and submits diagrams which indicate a close relation between solar disturbances and terrestrial temperature. He presents also studies of the relation of solar conditions to climatic variations, storms and electrical activities. This volume no doubt would be of less interest to the engineer than to members of certain other of the scientific professions but is of value to those engineers who are interested in studying the causes of the various climatic changes, including the distribution of moisture and variations in temperature.

The results of the study showing the relation of sun spot occurrence to rainfall are not conclusive so far as the rainfall in the northeastern part of this country is concerned, but such a comparison is difficult because of the limited period available for comparison as presented in this volume. Further study along the line indicated would be of great interest and might prove most valuable.

The correlation of data in this book must have required much research work on the part of the author, and the results of his interesting studies should encourage further investigation along the same lines.

Civilization and Climate, now in a second edition, is an investigation of the influence of certain climatic

conditions upon health and industry in various parts of the world and is interesting to engineers as well as to geologists, geographers, meteorologists, historians and others who have made less general studies of similar subjects. The writer traces a connection between climate and health, especially in human progress, in a very interesting way. It is somewhat unfortunate, however, that more detailed information is not presented in the appendix to assist those readers who might be interested in ascertaining the facts from which the conclusions in this volume are derived. The addition of this information would have enabled students of the subject to carry the matter further and make other comparisons without going over again the data from which the information was collected. It is hoped that certain other volumes which the author is about to publish may include the exceedingly valuable information which he has collected.

Large High-Speed Reservoir Outlets

HIGH-PRESSURE RESERVOIR OUTLETS: A Report on Bureau of Reclamation Installations—By J. M. Gaylord, Electrical Engineer, and J. L. Savage, Designing Engineer. Washington, D. C.: Bureau of Reclamation. Part I: Cloth; 6x9 in.; pp. 179; 32 halftone plates and 44 figures in the text. Part II: Cloth; 8x11 in.; folding plates of detail drawings. Part I, $5; Part II, $10.

One of those rare government reports that form basic contributions to technical literature has been produced by Messrs. Gaylord and Savage. Their detailed account of Reclamation Service experience with large-volume, high-head valves and discharge conduits contains a record of practice unequalled by any other treatment of the subject. It promises to remain the principal document of the subject for many years to come. Their work is distinguished also by a clearness and simplicity of statement that makes the report additionally remarkable. An album of drawings accompanying the text increases its value and scope well beyond that of the ordinary text-book.

In attacking their subject the authors begin with a simply stated outline of its elements; the growth of the reservoir-outlet problem from early ages, the application of butterfly and simple gate-valves, and finally the development of large slide, cylinder and needle gates. Still following the schematic plan of presentation, they next describe the various types of outlet arrangement, involving the position of the valve, with reference to the discharge conduit and the provision of means for admitting air to weak vacuum and for getting at the valve to inspect or repair it. Losses in outlets are briefly discussed and some data are given concerning high-head outlets for large discharges.

The detailed treatment then takes up in succession the various valve types, most space naturally being given to the needle type, in view of its dominant position in this field. Then follows as the main part of the book a series of chapters dealing separately with outlet development at various high dams built by the Reclamation Service. The troubles encountered, how they were dealt with and to what extent they were solved are treated in full. This is the part of the book that assures its permanent position in the literature of engineering and entitles the authors to the thanks of the profession.

A section of quite independent value, printed as an appendix, is a bibliography of reclamation articles and books on irrigation, including in 33 pages several hundred entries.

Filtration Broadly Considered

REVIEWED BY ROBERT SPURR WESTON
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A TEXT BOOK OF FILTRATION: Industrial Filtration and the Various Types of Filters Used—By Charles L. Bryden, E. M., B. S., and George D. Dickey, B. S. Easton, Pa.: The Chemical Publishing Co. Cloth; 6 x 9 in.; 264 halftones and line cuts. $5.50.

As stated in the Preface, this book was written "to give the fundamental principles underlying filtration, the modifications necessary under varying conditions, the proper procedure for carrying on experiments, the available data on filtration and a description of the various types of filters which have been developed as a result of scientific research."

In the Introduction, the authors assume the particles of precipitates to be spheres for the purpose of making clear the theory of the art, yet are not misled into assuming that all particles of like volume offer equal resistance to filter media. Twenty-four clear photo-micrographs of precipitates illustrate the variations both in size and in nature of precipitates. The importance of microscopic examination in filtration problems is well developed. The relations between rate of flow, pressure and cake thicknesses are well illustrated by tables and formulas and the influences of viscosity and temperature concentration are likewise mentioned.

The practical laws of filtration given are: (1) As open a filtering medium as possible should be chosen. (2) If possible in any way to control precipitation prior to filtration microscopic examination and experiments should be carried on to determine the best form of precipitation for filtration. (3) In filtering non-rigid solids care must be taken to build up the pressure gradually and uniformly. (4) High pressures do not necessarily give hard dry cakes. (5) A thin cake offers lower resistance than a heavy and consequently gives a higher rate of flow, and easier washing and drying. (6) The cake should be as uniform in porosity and thickness as possible in order to get good washing and drying. (7) Lack of proper agitation in leaf filters gives pear-shaped cakes, and uneven or partial filling of a filter press produces a cake of varying porosity and thickness, both of which are undesirable. (8) The higher the temperature the lower will be the viscosity and consequently the greater the capacity of the filter.

The book contains an interesting history of filtration with a page devoted to the development of water and sewage filters. About eighty per cent of the space is occupied with descriptions of dewaterers, clarifiers, filters and presses, for removing the suspended matter from gases and all sorts of liquids—aqueous, oleaginous and organic. Indeed the spirit of fairness has led the authors into redundancy in describing so many makes of the same types of apparatus. For example, there are quite detailed descriptions of the products of a dozen makers of water filters and it is rather unfortunate that the apparatus are described with the makers' names rather than types of filters as headings.

The chapter on Centrifugal Machines contains valuable information, although it bears a strong resemblance to catalogue announcements, and the chapter on Air, Gas and Light Filters should be read by those who use air for the agitation of sewage and other liquids. Even the Cottrell process and color screens are described briefly. Laboratory filtration has a chapter devoted to it but there is no mention of the new "stream-line" filter.

In their chapters on Leaf and Frame and Leaf and Rotary Filters the authors have compiled much valuable information which, while of greater interest to the industrialist than the public-health engineer, should not be overlooked by the latter when studying the problems of dewatering and partially drying sewage sludges and the precipitates from factory wastes.

The chapter on Coagulants and Filter Aids is rather disappointing. The reviewer had hoped to read a popular statement of modern theories of coagulation but the theory of the past decade is employed. There are some good diagrammatic operating data given in a special chapter and descriptions of thickness, pumps, coagulant feeders, compressors, etc., are not wanting. Some good tables, useful for filter operators and others, are contained in the Appendix, among them one giving the proper materials and fittings to be used for pumps for handling various liquids, corrosive or otherwise.

While the book will be read more by mechanical and chemical engineers than by civil engineers, the reviewer commends it to all interested in filtration, especially to those sanitary engineers who have to dispose of troublesome solids. The expert on water-purification will find better information elsewhere.

Early Effects of the Steam Engine

CAPITAL AND STEAM POWER, 1750-1880—By John Lord, Bachelor Scholar of Christ's College, Cambridge. London: P. S. King & Son, Ltd. Cloth; 5x8 in.; pp. 253. 7½s. net.

With its full references to the original sources from which the greater part of its historical data were taken, this book is not only interesting as an historical document but is also an engaging account of the development of the steam engine and its introduction into the industrial life of England. As a background, the author has outlined the conditions in trade and industry in the period immediately preceding the introduction of steam power and the development of the capital system up to that time. Then comes a description of the early developments in atmospheric steam engines and their application to and effect on industry. This leads to an account of the development of Watts' engine, the method of financing it, and the uses of this improved means of power in developing the basic industries of the country. The book closes with a review of the condition of capital and labor in 1800 and a discussion of the importance of the work of such energetic men as Watts in raising the standards of industrial life to their present level.

Spanish Railways

THE RAILWAYS OF SPAIN—By George L. Boag. Author of "Manual of Railway Statistics." London: The Railway Gazette. Cloth; 6x9 in.; pp. 129; halftones and line cuts. 12s. net.

The Railways of Spain, as the title would indicate, is a description of the Spanish railways from the time of their inception until the present day, with a discussion of their future and of nationalization and government intervention. The author's knowledge was gained during several years of experience in the management of a railway in Spain. The book gives the essential facts concerning the railways, starting with the original construction and financing by the aid of government subventions and continuing with a discussion of present-day conditions, earnings, fares and rates, and descriptions of typical structures and equipment. The last chapter is devoted to a brief outline of the railways of Portugal.

This is a book that should be read by all advocates of government ownership, because of its exposition of the results of "too much government" in the railways.

Tremors and Noise Caused by Machinery

THE PREVENTION OF VIBRATION AND NOISE—By Alec B. Eason, M.A. (Cantab.), Assoc. Inst. C.E., A.M.I.E.E. [Oxford Technical Publications.] London: Henry Frowde and Hodder & Stoughton; New York: Oxford University Press. Cloth; 6x9 in.; pp. 163; 65 halftones and line cuts. $5.

Tremors and noise transmitted from moving machinery through buildings or through the ground are the author's subject in this work. His text is essentially a bibliographical summary of what various people have studied and written on this topic. Its perusal gives a definite impression of the primitive state of the subject, but for this very reason the book may prove a convenient starting point for many who will have to deal with practical problems in transmission of tremors.

PUBLICATIONS RECEIVED

VENTILATION OF CENTRAL STATION BUILDINGS AND EQUIPMENT, a report of the subcommittee on ventilation of the Electrical Apparatus Committee, Technical National Section of the National Electric Light Association, is a study of the laws governing the movement of air and their use, both in present practice and in proposed installations, for the ventilation of central station buildings and prime movers. The paper gives a number of diagrams of air movement in typical installations and tables of air duct sizes, also a description of various types of ventilating machinery. (National Electric Light Association, New York City; 25c. to members; non-members, 40c.)

THE INSTITUTION OF CIVIL ENGINEERS (London) has issued a second supplement to its investigation on the Deterioration of Structures in Sea Water, called The Third Interim Report. The latest appendix gives further reports of the behavior of steel in wood, in sea water, in various marine exposures of the British Empire and throughout the world. Concrete is not discussed. (London: H. M. Stationary Office; 3s. 2d.)

THE VERY HEAVY REINFORCED-CONCRETE SLAB BEAMS tested during the war in the interest of concrete ship construction have been made the subject of Technologic Paper No. 233 of the Bureau of Standards (Washington, D. C.) entitled Tests of Heavily Reinforced-Concrete Slab Beams, Effects of Direction of Reinforcement on Strength and Deformation, by W. A. Slater and Fred D. Seely. The results give some useful information on the behavior of diagonal reinforcement in thin slab beams.

LAST YEAR at the American Concrete Institute, Prof. W. K. Hatt, of Purdue University, gave some preliminary information on studies to prove the value of the ball test as a determinant of the quality of concrete. More elaborate notes on these tests are now supplied in a bulletin entitled Ball Test Applied to Cement Mortar and Concrete, by R. B. Crepps and R. E. Mills. (Purdue University, Lafayette, Ind.)

THE UNITED STATES BUREAU OF MINES (Washington, D. C.) has issued a Bibliography of Magnesian Cement, by G. H. West, R. L. Sebastian, and W. A. Darrow. It was compiled in the course of research work on the utilization of magnesite in the West.

THE DEPARTMENT OF COMMERCE, Bureau of Foreign and Domestic Commerce, has issued as miscellaneous series No. 119 a bulletin on Inland Water Transportation in the United States. It has a prefatory section on the economics of inland waterway transportation generally favorable to that neglected field, and is followed by a categorical descrip-

tion of all of the waterways in the United States and an appendix giving a digest of the various governmental reports on inland waterways.

DR. J. A. L. WADDELL delivered two addresses at Brown University in September, the first entitled Some Observations on the Regeneration of China and the Engineering Work Involved Therein, and the second, Functions of Both Pure and Applied Science in the Future Development of China. Both of these are now available in one small volume. (The author, 35 Nassau St., New York City.)

ELEVEN 20x14-IN. CHARTS in a flexible loose-leaf binder have been prepared by E. V. Willard, Commissioner of the State Department of Drainage and Waters, St. Paul, Minn., giving the flow capacities of ditches and tile drains of various sizes and slopes. There are also three sheets of text. These charts have been prepared under a state law which authorizes the department to issue and publish "rules and regulations" for the information and guidance of officials in public drainage proceedings operating under the state drainage laws. The intention, therefore, is to furnish them only to engineers within Minnesota. They are not for sale and the extent to which outside engineers can be furnished with the charts is left to the discretion of the Department. There is only a limited edition.

THOSE WHO HAVE OCCASION to use population figures will welcome the Census Bureau's Estimates of Population of the United States by States and Cities, 1910 to 1923, and Area July 1, 1923 (15c. from Superintendent Public Documents, Washington, D. C.).

INDUSTRIAL ORGANIZATIONS with many workmen may find useful an illustrated pamphlet on Change Houses in the Lake Superior Region, by Cleve E. Kendall, Mine Car Surgeon, U. S. Public Health Service. (One copy to a person free while they last from U. S. Bureau of Mines; 15c. from Superintendent of Documents, Washington, D. C.)

STANLEY PINEL has written and the Engineering Extension Department, Iowa State College at Ames, has published a 38-p. illustrated pamphlet on The Operation and Care of Sewage-Treatment Plants.

METER INSTALLATIONS AND METER RATES is the title of a short paper by E. I. Roberts, assistant engineer, Ohio Department of Health, Columbus, Ohio, published by the department. The paper is a response to a demand for information from officials of Ohio municipalities "brought about by the increased cost in the operation of waterworks." Diagrams are included..

SMOKE ABATEMENT—domestic, industrial and locomotive—is reviewed by Osborn Monnett in a bulletin issued by the U. S. Bureau of Mines. There is a section on city smoke ordinances. (Washington; one copy free from the Bureau of Mines; 15c. from Superintendent of Documents, Washington, D. C.)

IN SUPPLEMENT 23 TO THE MONTHLY WEATHER REVIEW, Washington, D. C., Jesus Hernandez, an engineer, takes up the Temperature of Mexico. (Free to U. S. Weather Bureau Co-operators; 10c. from Superintendents of Documents, Washington, D. C.)

New Books and Revised Editions

ELEKTRISCHE TEMPERATUR-MESSGERÄT — Von Dr.-Ing. Georg Keinath. Munich and Berlin: R. Oldenbourg. Paper; 7 x 10 in.; pp. 275; 219 figures in the text. Paper, $2.40; cloth $2.65 (both in Germany.)

ELECTRO-CHEMISTRY RELATED TO ENGINEERING—By W. R. Cooper, M. Inst. E. E.; Assoc. M. Inst. C. E.; Fellow Inst. Physics. (Edited by Bertram Blount, F.I.C.). New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 136; 53 line cuts and halftones. $3.75.

Among the chapters there is a long one on Electrical Precipitation of Dust, Smoke and Fume, and there are two short ones on Electrolytic Corrosion by Stray Earth Currents and the Relative Importance of Cheap Power and Cheap Freight.

ELEMENTS OF ENGINEERING THERMODYNAMICS—By James A. Mower, James P. Calderwood and Audrey A. Potter. [Second Edition, Revised.] New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 228; 75 figures. $2.50 net.

ENGINEERING DRAWING—By H. H. Jordan, Head Department of General Engineering Drawing, University of Illinois; and R. R. Hoelscher, Assistant Professor of General Engineering Drawing, University of Illinois. New York: John Wiley & Sons; London: Chapman & Hall, Ltd. Cloth; 6 x 9 in.; pp. 351; lettering charts, line cuts and halftones. $3 (15/-net).

The authors state that they have included these "five kinds of materials" in their book: "(1) Elementary fundamental theories and concepts underlying all forms of Drawing; (2) illustrations explaining the theory and demonstrating proper modes of execution; (3) complex but related principles; (4) encyclopedic or handbook materials—sometimes called commercial practices; and (5) problems." Principles are laid down and are applied to architectural, structural, map, patent office, and other kinds of drawings. A chapter on the principles of graphic methods is believed by the authors to be new to this kind of a book. Bibliographies are given at the close of the more advanced chapters.

GRAPHICAL ANALYSIS OF STRESSES INVOLVED IN DESIGNING FRAME STRUCTURES; Intended Primarily for Students of Engineering—By G. P. Schubert, Assistant Professor, Department of Civil and Mining Engineering, Michigan College of Mines, Houghton, Mich. Houghton, Mich.: Published by the Author. Cloth; 6x9 in.; pp. 139; 99 line cuts and halftones.

LEHRBUCH DER EISENHÜTTENKUNDE; Verfasst für den Unterricht, den Betrieb und das Entwerfen von Eisenhüttenanlagen—von Dr.-Ing. E. H. Bernhard Osann, Professor an der Staatlichen Bergakademie in Clausthal, Geheimer Bergrat. Erster Band; Roheisenerzeugung, Zweite, Neubearbeitete und Erweiterte, Auflage. Leipzig: Wilhelm Engelmann. Cloth; 6 x 9 in.; pp. 923; 523 figures in the text.

Revised and much enlarged edition of the volume on Pig Iron Production (the Blast Furnace) of the author's Treatise on The Metallurgy of Iron. The first edition was reviewed and highly commended to "every iron and steel producer and metallurgist" by Dr. Richard Moldenke in these columns, Dec. 16, 1915, p. 1175. The companion volume, on Iron and Steel Making Processes based on Blast Furnace Products, was also favorably noticed by Dr. Moldenke, Jan. 19, 1922, p. 121.

MACHINE DESIGN DRAWING ROOM PROBLEMS—By C. D. Albert, M. E., Professor of Machine Design, Cornell University; M. Am. Soc. M. E. New York: John Wiley & Sons. Cloth; 6 x 9 in.; pp. 320; 19 line cuts. $3. 15s. net.

MUNICIPAL GOVERNMENT AND ADMINISTRATION: VOL. I, GOVERNMENT; VOL. II, ADMINISTRATION—By William Bennett Munro, Ph. D., LL.B., Professor of Municipal Government in Harvard University. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 459 and 517. $3 per volume.

PONTS ET COMBLES MÉTALLIQUES — Par T. Godard, Ingénieur en Chef de la Construction a la Compagnie du Midi, Professor a L'École Nationale des Ponts et Chaussées. Avec le patronage de la Société des Ingénieurs Civils de France et de la Société d'Encouragement pour l'Industrie Nationale. [Encyclopedie du Génie Civil et des Travaux Publics]. Paris: J.-B. Baillière et Fils. Paper; 6 x 9 in.; pp. 667; halftones and many line drawings.

PROJECTIVE GEOMETRY, WITH APPLICATIONS TO ENGINEERING—By Peter Field, Professor of Mathematics, University of Michigan. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 98; 74 line cuts. $2.

PUBLIC SPEAKING FOR BUSINESS MEN—By William G. Hoffman, Associate Professor of Public Speaking, Boston University, College of Business Administration. New York and London: McGraw-Hill Book Co., Cloth; 6 x 8 in.; pp. 300. $2.50.

STRESSES IN FRAMED STRUCTURES, Compiled by a Staff of Specialists—Editors-in-Chief: George A. Hool, Consulting Engineer, Professor of Structural Engineering, University of Wisconsin; and W. S. Kinne, Professor of Structural Engineering, University of Wisconsin. New York: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 620; 485 line cuts. $5.

TECHNICAL WRITING—By T. A. Rickard, Contributing Editor of *Engineering and Mining Journal-Press*. [Second Edition, Rewritten and Enlarged.] New York; John Wiley & Sons.; London; Chapman & Hall, Ltd. Cloth; 6 x 8 in.; pp. 337. $2 postpaid (10/-net).

The first edition was noticed in these columns May 20, 1920. A portion of the volume has been rewritten. Chapters on the wrong word and on punctuation have been added.

A TRANSITION CURVE—By J. E. Williams, Professor of Mathematics, and R. B. H. Begg, Professor of Civil Engineering, Virginia Polytechnic Institute. [Bulletin No. 1 of Engineering Experiment Station, Blacksburg, Va.] Paper; 6 x 9 in.; pp. 35; illustrated.

The "Lemniscate" curve is the particular form of transition dealt with in this pamphlet, and the treatment is an enlargement of an article by Professor Williams in *Engineering News-Record* of Aug. 26, 1920, p. 406.

WEATHER PROVERBS AND PARADOXES—By W. J. Humphreys, Ph. D., Meteorological Physicist, U. S. Weather Bureau. Author of "Physics of the Air." Baltimore: Williams & Wilkins Co. Cloth; 5 x 8 in.; pp. 125; 18 halftones and line cuts. $3 in United States, Canada, Cuba, Mexico; $3.50 elsewhere.

Cites many folk-sayings, mostly in rhyme, about the sun, moon, stars, fogs and clouds in relation to the weather and explains their scientific basis in easily understood language. Paradoxes are likewise explained. Contains good halftones pertinent to the text including rainbow and cloud effects.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Constructing Engineer on Apishapa Dam Failure

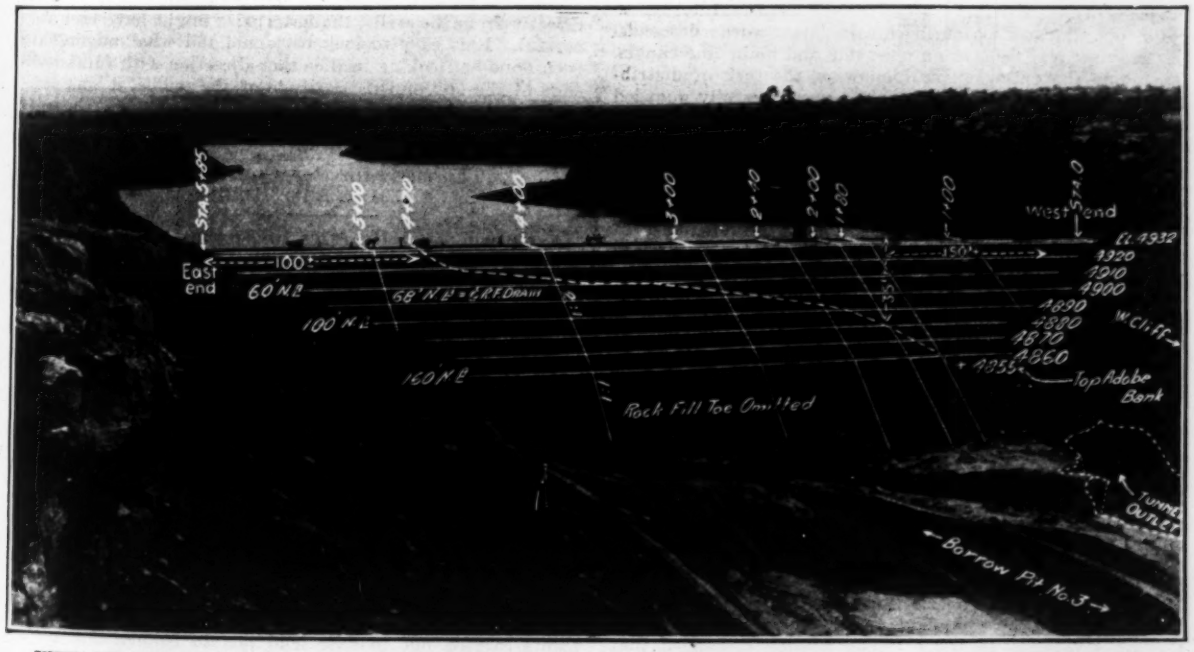
Sir—Since I served, from Aug. 30, 1918, to Sept. 18, 1920, as engineer in charge for the Apishapa Consolidated Irrigation Co. of Fowler, Colo., owner of Apishapa dam which recently failed, and since I also was inspecting engineer for the state engineer, A. J. McCune, who was also actively the consulting engineer to the said company throughout that part of construction subsequent to my employment, I take it that information which I have to give will be of interest to the profession.

The plans prepared by the writer were, with the exception of the plans for outlet works and steel cutoff wall with its various appurtenances, and the rock-fill toe of embankment, merely filed with the state engineer as a record of the changes made in previous plans, so that the plans on file would correspond with the dam as built. Unfortunately, the writer was not permitted to work out such plans for the embankment as he believed were necessary, for the reason that two former sets of plans, already approved, laid down lines which the company and state engineer believed adequate, and the writer was unable to persuade any of the parties concerned that important increases in crest dimensions and slopes were advisable.

I assume that it is not necessary for me to repeat a description of the "phenomena" attending failure of the dam, since these have, as I believe, been clearly and fairly set forth in the report of Floyd and Jones in your issue of Sept. 13, p. 422. I ask you to publish the enclosed photograph, which shows the stationing of the dam, and the elevation at which water issued at time of failure. The point seems to be considerably lower than stated in all reports heretofore. Stationing of the crack across the dam can also be followed, and anyone interested in speculating upon the relation of settlement cracks to the deeper portions of the fill can do so from this photograph and the plan of the dam in your Sept. 13, issue.

I would like to deal at length with the "causes" of the failure but to touch upon all the causes which contributed to this failure would require so much space that I will limit myself to the following summary: (1) The design of the embankment was inadequate for a dam at the location chosen; (2) the company's financial program was inadequate, and had a vital bearing upon the contractor's methods, and the engineer's power to rigidly enforce the contract; (3) the engineer's specifications were tampered with by a board of directors which, although it contained two "graduate" engineers, did not realize the fact that the utmost care was required to build a dam that would be safe; (4) the contractor after the company had defaulted financially, felt compelled to take the work into his own hands and complete it so as to save himself financial loss; (5) the writer, throughout his connection with the job, was practically the only one who insisted upon the use of thorough construction methods, and was not sustained in his contentions by the state engineer, and but for the writer's insistence, the dam would have been built without either sprinkling or rolling; and (6) had the writer's recommendations been put into effect, the dam would have had a much wider top and heavier section, and would have been constructed of materials all from the canyon bottom—*none from the hilltop*—and all layers 6 in. instead of 12 in. thick. There would have been no omitted rock-fill toe—no unlined tunnel—and far less of settlement cracks. The dam should have been constructed so that settlement *could not* have amounted to much, and here was fundamentally where the writer differed with the state engineer and the company officials, and its two "engineer" directors, all of whom contended that "settlement, even if it *did* occur, would not be a serious matter."

Throughout the construction of the dam, the writer was forced to fight for the incorporation of features of design which he felt were in accord with sound engineering practice, and without which the dam could not be made safe. It was a losing fight. Had it not been for his efforts, Apishapa dam would have been even more unstable than it



VIEW OF APISHAPA DAM SHOWING WHERE WATER BROKE THROUGH LOWER SLOPE JUST BEFORE FAILURE

From a photograph supplied to Mr. Mann by A. J. McCune, lately state engineer of Colorado. To the upright lettering and the dotted line originally supplied by Mr. McCune there have been added by Mr. Mann the inclined lettering and the solid lines. A duplicate of the original view, without lettering, was reproduced on a smaller scale in *Engineering News-Record*, Aug. 30, 1923, p. 358, and the same view, with Mr. McCune's lettering and broken line only, Nov. 29, p. 901.

proved to be. Had his ideas prevailed, the dam would have had a better chance, at least, of being in place today.

Having in all ways tried to bring about the construction of this dam along safe lines, and, failing in this, having warned the proper authorities of the danger attached to improper use of the, as yet, uncompleted structure, the writer thinks he discharged every duty that could reasonably be expected of him—even to "running the level" Mr. Fellows mentioned on p. 776 of your issue of Nov. 8.

In closing, I wish to say that failure of this dam was due to inadequate design, inadequate financial program, improper construction methods, use of material other than that specified and last, but certainly not least, *improper use of a reservoir the dam of which was known to be unsafe for storage to high water line.* A written order and a padlock could have prevented the whole disaster. Reasonable use of the reservoir might have been ordered until proper increases in section, and studies of incipient failure, were made.

As to the character of material complained of by Messrs. Field and Fellows, I am content to ask these gentlemen to read, on p. 53 of *their* 1911 report, the excerpt that follows, and then tell the profession what magic change took place in these materials between 1911 and 1923 that rendered the materials, formerly "good" to be now "unsuitable":

"There is a large amount of soil in the canyon both above and below the dam, *suitable for an earth embankment.* There is also *good dam* material on the high ground to the east of the canyon, and in the reservoir basin itself, so that there is an abundance of material comparatively handy *and suitable in character.*" [Italics mine.] The materials actually used in the dam came from points which they have above described. CLAIR V. MANN.

Rolla, Mo., Nov. 15, 1923.

Why the Garden City Project Failed

Sir—Referring to the letter of George S. Knapp, State Irrigation Commissioner, regarding the Garden City, Kan., reclamation project (*Engineering News-Record*, Dec. 6, 1923, p. 943), the outstanding thing is the apparent lack of a full comprehension of the original intent and scope of the Reclamation Act under which this project was built.

When the law was discussed and passed it was for the purpose of authorizing the Secretary of the Interior to build, operate and maintain certain large works described in Congressional debates as reservoir and main line canals, leaving to the entrymen or landowner the task of distributing the water. The law was also very carefully guarded against committing the government in advance to any cost, and provided in express terms that the cost should be announced by the Secretary after the contracts were let. This was because much of this work was known to be experimental and the Congress was not willing that the Secretary of the Interior should be put in the position of a contractor guaranteeing any specific statements as regards cost or quantity of water to be delivered.

Each Secretary concerned issued drastic orders to the effect that no preliminary estimates could or should be considered as binding and in all cases care was taken to show that any such statement of possible or probable cost of any particular piece of work had no binding effect and could not, until the contracts were let and the Secretary had taken formal action. This has been sustained by the courts who have called attention to the intent of the law and to the care taken by all responsible parties from the Secretary down, to assure each one interested that the preliminary statements were what they purported to be and could not be construed as binding.

The Reclamation Act also provided that work should be begun in each of the states named, among them Kansas. Field examinations had been made in that state for many years and carefully conducted efforts to ascertain the location of a feasible project. Public opinion demanded that some of the Reclamation Fund be expended in Kansas. There was also a widespread belief that the so-called underflow would furnish vast volumes of water. Investigations were made of the rate of flow of water percolating underground and although there were reasonable doubts as to the practicability of bringing this water to the surface in large quantities yet no engineer at that time had sufficiently complete information to be able to withstand the overwhelming popular pressure for a large demonstration of the feasibility of pumping water from this supposedly great underground reservoir. Moreover this question of cost was met by the invariable reply, "We do not care what the water may cost; $100 an acre would be cheap if we can get it."

Under these conditions the Secretary of the Interior, yielding to the insistent demand from all sides, ordered that a large demonstration pumping plant be built. He did not obligate himself to furnish any specific quantity of water or at any specified amount of money. He expressly forbade any advance estimates to be considered other than what they purported to be, namely, statements as to the probable cost of the specific works to be built. This was as far as he could go under the law and as far as he would authorize his engineers to proceed.

Remember at all times that the Reclamation Service so-called has practically no legal existence. It is simply a body of men created by the Secretary of the Interior acting under his orders to carry out the intent of the law. These men cannot proceed a step beyond the express authority of the Secretary. He may ask them for opinions and estimates and he may order them to carry out certain work but they cannot in any way obligate him nor can they bind him by stating informally what in their opinion certain works may cost.

In other words, the Garden City pumping project was carefully planned to ascertain whether water could be pumped in a large scale from underground. It was known that it could be had in quantities practically inexhaustible to the pumps then used but until a series of these was located across the valley the limitations of supply could not be determined.

Had the country been more nearly arid, as for example in portions of California, such a pumping plant might have been highly advantageous but under the conditions which then prevailed in western Kansas the work, although well planned according to the engineering information then available, and carried out well within the estimates of the engineers, was not successful, although it is quite probable that had an equal number of wells been more widely distributed and located within an irrigable tract, reached directly from the wells, the enterprise might have been successful. It is easy to look back and tell what might have been done but looking in the other direction with full knowledge of the law and the attitude of the public, it was obviously impossible for any Secretary of the Interior to have refused to carry out the demand for a pumping plant in the Arkansas Valley. F. H. NEWELL,

Formerly Director, U. S. Reclamation Service.

Washington, D. C., Dec. 1, 1923.

Creosoting Practice on Indian Railways

Sir—I have read with interest on page 857 in the May 17, 1923, issue of your valued publication an editorial entitled "Courageous Pioneering" which deals with the treatment of ties with a mixture of 30 per cent creosote and 70 per cent fuel oil. It may interest your readers to know that about 10 years ago we started experiments by treating sleepers with 50 per cent fuel oil and 50 per cent creosote, which so far have given very fair results.

Some of the Indian railways have been so impressed by these experiments that they have erected pressure-treating plants to treat railway ties with varying percentages of creosote and fuel oil. As an example I may cite the North Western Ry., which has the longest railway system in India. This road is treating pine and fir sleepers with 75 per cent creosote and 25 per cent fuel oil. The Assam Ry. has also just erected a plant and is considering using as little as 33 per cent creosote and 67 per cent oil. The experiments carried out to date lead one to believe that equal proportions of the two oils will preserve the timber beyond the period when such sleepers will have to be rejected for mechanical defects.

Dehra Dun, India, Nov. 6, 1923. RALPH S. PEARSON,

Forest Economist, Forest Research Institute.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Zoning in the West Philadelphia section of Philadelphia has been postponed by the City Council until after Jan. 1, when there will be a change in administration. It is hoped that conflicting interests, in and out of the Council, can then be harmonized.

The Board of Water Commissioners of the city of Detroit has issued formal invitations to the placing in operation Dec. 22 of the new filtration plant. Admission is by ticket. This 320-mgd. plant, the largest of its kind in the world, was described in *Engineering News-Record*, May 17, p. 860.

The Saranac Co. of Plattsburg Has made application to the New York State Public Service Commission for authority to acquire and own the capital stock of the Saranac River Power Corp., a corporation which is now building a new power plant and dam about four miles west of Plattsburg, N. Y.

Contract for the Construction of a 60,000-hp. hydro-electric development on the Ottawa River at Bryson, Quebec, has been awarded by the Ottawa River Power Co., to Fraser, Brace, Ltd., engineers, Montreal. The total expenditure on this work will be approximately $3,000,000, and it is expected to have the first unit installed by Dec. 1, 1924.

Electrification of the London Suburban lines of the Southern Ry., England, is to be extended materially, according to plans recently approved by the company. At present there is electric operation on 85 route miles with 248 miles of track, but by the end of 1925 these figures will be increased to 145 and 358 miles, respectively. This work is estimated to cost $26,000,000.

Nine-Mile Bridge, a Dangerous highway crossing over the New York Central R.R. between Schenectady and Amsterdam, is to be replaced by a new bridge at a more advantageous location, east of the present bridge. This change is the result of an agreement between the railroad company and the New York Bureau of Highways. The estimated cost of the work is $141,000, which cost will be divided between the railroad company and the state.

In Order to Increase the Low Flow capacity of the Ontario hydro-electric plant at Cameron Falls on the Nipigon River, in northern Ontario, the engineers of the commission are studying the possibilities of diverting the waters of Long Lake, a 50-mile long lake just over the height of land from the Lake Nipigon drainage area, from its present drainage north to Hudson Bay, into Lake Nipigon. The peculiar formation of the land between the two drainage areas makes such a proposition possible

Proposed Anti-Oil Pollution Bills Before Congress

Bills have been introduced in each House of Congress providing that it is to be unlawful to pollute any of the navigable waters of the United States with oil or other refuse other than sewage from streets, sewers or vessels. Violations are made punishable by fine not exceeding $1,500 nor less than $500, or by imprisonment for not less than thirty days, nor more than one year.

Engineers Again To Discuss Department of Public Works

In connection with the annual meeting of the Federated American Engineering Societies to be held in Washington Jan. 10-11, a special meeting will be held on Jan. 9 to forward the formation of a Department of Public Works under the Department of the Interior. This meeting will be called the National Conference on Public Works and will be attended by engineers and architects, instructors, manufacturers, chemists, geologists, economists, and business men from all over the country. Local committees of the old National Public Works Department Association will be revived for the period prior to the meeting.

It is the intention, it is announced, of those who are calling the meeting to recommend the adoption by Congress of a bill embodying that part of the Brown plan of government reorganization which provides for the reorganization of the Department of the Interior, so that that department has two divisions, one of which will be devoted to public works and will include all the engineering activities of the government.

A.G.C. Ballots for Officers

Official ballots have been sent members of the Associated General Contractors of America, election for officers to be announced after ballots have been canvassed Dec. 31.

The list of names on the official ballot follows:

For president (to serve one year)—F. L. Cranford, president, Frederick L. Cranford, Inc., Brooklyn, N. Y.; vice-president-at-large (to serve one year)—A. S. Downey, (partner) A. W. Quist Co., Seattle, Wash.; vice-presidents (to serve until 1927) Zone 1—Leonard C. Wason, Aberthaw Construction Co., Boston, Mass.; Zone 2—H. H. Wilson, Winston & Co., Harrisburg, Pa.; H. R. Blagg, H. R. Blagg Co., Dayton, Ohio; directors (to serve until 1927); Districts 2 and 3—W. A. Rowan, James Stewart Co., New York City; District 7—T. J. Baker, Coddington Engineering Co., Milwaukee, Wis.; L. D. Townsend, Townsend, Shuttleworth, Ballmer Co., Lansing, Mich.; District 8—Henry Ericsson, Henry Ericsson Co., Chicago, Ill.; District 13—Natt MacDougal, A. Guthrie & Co., Portland, Ore.; Districts 14 and 15—H. W. Baum, H. W. Baum & Co., Salt Lake City, Utah.

Width and Thickness To Be Added to California Roads

Contracts to the total value of $5,000,000 will be made within the next few months, according to a statement made recently by R. M. Morton, state highway engineer, for widening and thickening existing paved routes on California's highway system. Plans and specifications for this work, which includes stretches of road in many parts of the state, are now in course of preparation and in some cases bids have already been called for. This expenditure will be made from funds derived from the state's share of the new gasoline tax and motor vehicle license fees and is in addition to money available from state highway bond funds. It is estimated that this new source of revenue for highway maintenance will be at least $7,500,000 for 1924, which is 50 per cent in excess of the present revenues for maintenance and reconstruction. The highway commission is to receive its first allotment from the gasoline tax in May, 1924.

Surveys and plans are also under way for considerable construction work on main trunk lines, which is classed as primary construction, and is paid for from bond issues. This work is kept separate from that classed as maintenance and rebuilding, for which the gasoline tax is specifically reserved by law. Primary construction to be undertaken soon includes the paving of 9.9 miles of the highway immediately north of Redding, grading a number of units on the Truckee River route between Auburn and the Nevada state line; work on the Redwood highway north of Eureka to make a connection with the Oregon state highway to Grants Pass, and connections with Yuma, Ariz., in southern California.

Commerce Commission Reverses Decision Against Coal Road

The Interstate Commerce Commission has reversed its decision of June 25 against permitting the Virginian Ry. Co. to build a 1.19-mile extension of its Guyandot River branch in Wyoming County, West Va. into new coal mines. The former decision was based on the claim that the applicant railway was unable to supply cars for the mines now served by it. The Commission also stated that there were more mines open than were necessary for the country's demand and the efficient use of the carriers equipment.

The reason for the reversal is based on the fact that the applicant company has made large increases in its equipment and also plans to increase its capacity by electrification. Moreover the Commission holds that to deprive the coal company of the opportunity to develop these fields would cause it to lose the value of large expenditures which it has made. It also finds that the coal to be mined is Pocahontas smokeless coal, which is in demand on account of its special properties.

Engineers Urged to Take Greater Interest in Civic Affairs

Washington Correspondence

Twice within a week assemblies of engineers in Washington were urged to advocate greater political activity on the part of their members. The first instance was at the convention of the chemical engineers. One speaker asserted that of all the chemical engineers in attendance at the convention, only one had been particularly active in politics.

The other admonition along this line came from President Loweth, of the American Society of Civil Engineers. In an address Dec. 11, before the Washington Section of the Society, he stressed the need for greater attention to public affairs on the part of engineers individually and collectively.

No other profession is as well paid by the communities they serve than is the engineer, Mr. Loweth said. He admitted that the lawyers might contest the statement, but if the earnings of that profession were stripped of profits from real estate and other outside activities, it would be found that their earnings for strictly legal work would show a lower aggregate than that of the engineering profession. Were engineers to take a larger interest in civic matters, even greater returns would come to the profession, but above and beyond the matter of increased earnings, the engineer, he believes, has a duty as a citizen.

Referring to the removal of A. P. Davis from the Reclamation Service, Mr. Loweth said this injustice to an engineer should not discourage engineers from giving service. Very frequently, he said, service is not rewarded as it should be, but the obligation to perform it remains nevertheless.

Reclamation Finances Tabulated

A tabulation of cost, repayments, water charges, and similar data for the various projects of the U. S. Reclamation Service has been prepared in the Department of Interior for the use of the Committee of Special Advisors on Reclamation. The tabulation is reproduced substantially complete herewith. It includes the Buford-Trenton, Hondo, and Garden City projects that have been abandoned by the government, and the Riverton project, yet under construction. It is to be understood that the figures given as originally estimated cost did not contemplate supplemental construction, such as subsequently entered into the actual cost. Included in the cost of construction, further, is a total of $12,922,455, representing the cost of furnishing water under Warren Act and other special contracts. The construction cost figures also include arrears in payment for water charges that have been transferred to construction by act of Congress or departmental order. The water charges given in the table include an item of $1,059,864 representing the cost for the first six months of 1923, for which no assessments have yet been made. The acreages do not include areas to which water is furnished under the Warren Act or other special contracts.

Three projects, Grand Valley, King Hill, and Milk River have not yet been opened by public notice and water is being sold on a rental basis. The Salt River acreage includes some area taken in by the Salt River Valley Water Users Association, on which the association spent additional money for construction. The cost of the Yakima project includes $2,515,875.62 expenditure on the Rimrock dam, which is expected to bring additional acreage under irrigation.

In a statement accompanying the tabulation the following remark is attributed to Secretary of the Interior Work: "The Reclamation Service of the government has had but two directors in its history of twenty-one years, both engineers and each with ten years' service. They have erected their own monuments and the different projects are writing the inscriptions for them."

Yuma Flood Protection Bill Before Congress

Protection against the Colorado River flood danger at Yuma, Ariz., would be assumed by the United States Government under a bill just introduced in Congress by Senator Ashurst, of that state. The bill provides an annual appropriation of $100,000 for such work, and a single appropriation of $100,000 to refund past expenditures on flood fighting, which heretofore has been charged against the Yuma irrigation project as part of operation and maintenance. The bill also declares it to be the policy of the United States to assume the obligation of caring for the river-front work and levee system on the Yuma project.

Two Power Developments Proposed For the Upper Delaware

The Shohola Water Power Co., the Bingman Water Power Co., and the Blooming Grove Water Power Co., have declared their intention jointly to construct two power plants on Shohola Creek, a tributary of the Delaware River, in northeastern Pennsylvania. They propose to construct a 60-ft. dam at the head of Shohola Falls and run a pipe line to a point downstream where they can develop a head of 270 ft., at which point they will construct a power house with two 4,000-hp. units. A second dam is being constructed at Cold Spring Lake and a second pipe line to a power house, where a head of 290 ft. will be developed and three 4,500-hp. units installed. As the project calls for a storage of 2,500,000,000 cu.ft. of water, it is probable that the Federal Power Commission will take jurisdiction over it on account of its effect upon the flow in the Delaware River.

Reject River Diversion Project

The engineering staff of the Federal Power Commission has advised the Newman-Hirstel interests of San Francisco that it will recommend the rejection of their application for a preliminary permit to develop power by the diversion of the San Benito River from its natural course into the San Joaquin River. Investigations of the engineering staff have revealed that all the water of the San Benito is needed for irrigation. Moreover, the staff believes that the development of the river in its natural course is more promising and less expensive than the proposed diversion. The diversion would have the effect of lowering the level of ground water at points below the point of divergence and would almost certainly result in extensive litigation over damages.

Testing Materials Again Will Meet in Atlantic City

Announcement has been made by the executive committee of the American Society for Testing Materials that that society's annual meeting will be held at the Chalfonte-Haddon Hall Hotel, Atlantic City, N. J., Monday, June 23, to Friday, June 27, or Saturday, June 28, 1924.

TABULATION OF COST, REPAYMENTS, WATER CHARGES, ETC., ON RECLAMATION PROJECTS

Projects.	First cost: Original estimated cost.	First cost: Net construction cost to June 30, 1923.	Area: Original irrigable acreage.	Area: Acreage actually irrigated to supply 1923.	Area: Original estimated cost per acre.	Water users' charges: Actual cost per acre to 1923.	Water users' charges: Aggregate charge per acre to owners of public notice.	Water users' charges: Years of delivery.	Water users' charges: Amount paid on construction to June 30, 1923.	Operation and maintenance: Total operation and maintenance costs to June 30, 1923.	Operation and maintenance: Total operation and maintenance receipts to June 30, 1923.	Delinquencies: Delinquent charges, rentals of irrigation water to June 30, 1923.	Delinquencies: Amount unpaid by water users on construction, and for water rentals.
Salt River, Ariz.	$[illegible]	$10,[illegible]	[illegible]	213,170	200,330	$28.00	$49.50	$ 360.00	17	$ 891,613.92			$9,[illegible]
Yuma, Calif-Ariz.	2,701,176	9,026,546.52	78,760	63,200	53,570	35.10	142.80	$55 & $75	17	1,083,052.01	$1,447,960.99	$ 956,921.08	6,949,[illegible]
Orland, Calif.	663,000	1,091,799.87	17,000	20,670	15,120	39.00	52.80	$ 46.00	$11.00	240,614.58	218,610.67	200,251.58	698,[illegible]
Grand Valley, Colo.	4,565,000	4,017,851.78	21,000	20,000	13,170	66.00	133.90	Rental basis	9			52,904.63	4,[illegible]
Uncompahgre, Colo.	2,300,000	6,715,074.11	100,000	97,410	64,350	28.00	68.90	70.00	16	102,70.34	81,794.16	1,543.60	36,351.96
Boise, Idaho.	9,867,800	17,731,405.75	371,000	143,000	112,000	26.55	89.00	$ 80.00	18	1,908,314.08	1,631,887.35	1,424,251.14	13,127.47
King Hill, Idaho.	1,000,000	1,681,241.45	17,000	13,600	6,440	64.66	137.75	Dist. Cost:	3			2,861.36	1,684,[illegible]
Minidoka, Idaho.	2,518,656	8,284,958.26	171,700	121,360	100,590	20.98	66.30	$30.00 & $40.00	17	2,866,034.34	1,381,916.18	1,198,418.06	267.60
Garden City, Kans.	256,000	340,651.07	8,600			30.00				51,176.11			334,[illegible]
Huntley, Mont.	600,000	1,474,406.81	35,000	32,000	19,523	25.71	46.10	30.00	16	364,055.23		309.52	1,640,[illegible]
Milk River, Mont.	7,426,452	6,782,063.22	258,000	68,000	50,000	79.48	101.70	Rental	13	1,110,000		23,470.81	6,784,[illegible]
Sun River, Mont.	7,372,400	6,215,845.14	256,000	62,470	20,530	28.80	100.00	$30 & $36	15	170,178.73	201,770.14	134,686.46	26,892.89
Lower Yellowstone, Mont.	2,039,218	2,110,448.22	66,000	20,200	15,000	30.90	77.35	45.00	14	41,232.70	744,420.61	62,361.97	1,396.50
North Platte, Nebr-Wyo.	3,500,000	13,692,160.32	100,000	167,240	111,620	35.00	84.30	56.00	16	1,742,767.58	2,052,353.08	1,347,035.73	584.11
Newlands, Nevada.	5,263,997	6,388,475.92	270,000	73,750	8,260	14.55	84.75	52.00	18	1,046,234.05	522,105.31	708,990.14	19.50
Carlsbad, New Mex.	607,000	1,393,996.79	20,000	25,000	24,060	30.00	56.75	45.00	17	391,377.34	683,724.56	405,595.17	
Hondo, New Mex.	275,000	371,867.17	10,000			27.50						35.49	
Rio Grande, N.Mex-Tex.	7,800,000	12,146,114.43	175,000	116,000	89,590	30.00	104.70	90.00	16	74,491.00	548,366.12	386,742.40	34,039.18
Williston, N. Dak.	230,460	460,107.18	8,795	7,600	1,590	26.75	60.15	38.00	16	8,250.50	357,244.00	28,586.51	
Buford-Trenton, N.Dak.	134,500	221,864.69	4,500			29.88					74,771.07	2,317.41	
Umatilla, Oregon.	1,086,000	2,652,309.89	20,140	24,380	13,770	53.90	109.10	$70 & $90	Dist. Cost	373,919.74	534,116.72	251,651.55	
Klamath, Oreg.-Calif.	4,897,311	5,974,462.70	236,401	54,000	38,000	18.59	77.90	$30 & $90	17	627,692.72	582,868.18	439,775.12	475.80
Belle Fourche, S.Dak.	2,335,000	3,847,045.07	79,000	82,190	31,150	29.55	45.15	$20 & $40	16	478,277.90	972,057.67	529,317.98	180.00
Strawberry Valley, Utah	2,722,000	3,166,968.00	60,000	53,890	30,620	45.37	64.30	$ 80.00	9	396,582.98	352,254.65	243,775.54	
Okanogan, Wash.	632,500	1,302,161.65	8,680	8,000	5,570	50.00	163.80	$95 & Dist. Contr.	16	84,427.70	379,212.10	223,082.51	1,442.97
Yakima, Wash.	6,045,800	12,161,931.67	181,768	133,240	123,700	36.00	91.20	$58 & $83	17	3,171,578.12	2,300,887.18	2,092,887.09	614.88
Riverton, Wash.	6,777,025	1,060,228.08	180,000			67.79							
Shoshone, Wyo.	4,310,238	8,290,865.42	110,000	71,280	42,780	39.18	116.40	$60 & $80	15-50	611,602.50	614,347.91	418,779.89	252.15
								$25 & $35					
Totals	$83,433,841	$143,767,006.11	3,056,579	1,892,909	1,202,150	$30.57	$85.74			$15,992,[illegible].48	$17,058,231.80	$11,370,744.09	$90,139.20	$22,062,[illegible].25

New Jersey to Bring Suit Against Federal Power Commission

Washington Correspondence

In an action similar to that taken by the state of New York against the Federal Power Commission, the state of New Jersey has now entered a motion for leave to bring suit against the commission to enjoin it from acting in that state "by an abuse of power without lawful and constitutional authority or in pursuance of wrongful and erroneous interpretations of the provisions" of the federal water power act, which act the state will ask the U. S. Supreme Court to declare unconstitutional.

The principal complaint of New Jersey is that the Federal Power Commission is attempting to exercise jurisdiction over the state's proposed development of water power along the Morris Canal. This canal, which runs from the Delaware River at Phillipsburg, N. J. to the Hudson River at Jersey City, was started in 1824, passed through various hands until it eventually came into the hands of the Lehigh Valley Ry. Co., and last year was purchased by the state of New Jersey. As the canal has ceased to be of value as a means of transportation the state proposes to use it to develop hydro-electric power by the construction of some new dams, including one on Lake Hopatcong. The state also proposes to develop power above Saxton Falls on the Musconetcong River and at various sites on the Delaware River. The motion cites that the state has not applied to the Federal Power Commission for permit for this work and does not propose to do so. The state also objects to the Commission's asserting authority over riparian land, which land brings in revenue to the state for its school funds, and to the Commission's interference with the conservation policy of the state in connection with its potable water on account of the possibility of its causing heavy losses in investments in waterworks. The state also challenges the Commission's right to regulate rates for the sale of electric power within the state.

Consulting Engineers Urge Tax Reduction

The tax reduction program proposed by Secretary of the Treasury Mellon was recently endorsed at a meeting of the American Institute of Consulting Engineers in New York City. The Institute, believing that a return to country-wide construction program in the industrial and railroad fields is passible only through restoration of public confidence by a reduction of federal taxes, addressed a letter recently to President Coolidge embodying the hope that the President would urge upon Congress the necessity of reducing taxes.

The subject of the tax reduction was taken up at the latest meeting of the Council of the consulting engineers, a resolution endorsing Mr. Mellon's program without qualification being unanimously adopted. The executive officers of the Institute were, therefore, directed to convey that expression to the Secretary of the Treasury and the chairmen of the appropriate committees of both the Senate and the House of Representatives, in addition to communicating directly with President Coolidge.

Corporate Management Suggested for Federal Barge Service

Washington Correspondence

Corporate management for the Mississippi-Warrior barge service has been suggested to the Secretary of War, and legislation to that end is to be introduced promptly. By the formation of a corporation, which will function under the Secretary of War, it is believed that most of the handicaps of government operation can be avoided, and a greater degree of flexibility injected into the administration of the service. The immediate direction of the service would remain in the hands of Col. Ashburn, the plan contemplates, who is to be released for the provisions of the Manchu law, and advanced to the rank of brigadier-general.

At the public hearing at which this plan was explained to Secretary Weeks, that official asked why the operation of the barge line should not be transferred to the Department of Commerce. Secretary Weeks made the point that something must be done to reduce the non-military functions which are being thrust upon the War Department. This led Senator Reed, of Pennsylvania, to inquire if it is proposed to transfer the Corps of Engineers to the Department of Commerce. He said he could not imagine a railroad having its operating division in one department and its maintenance-of-way in another. The suggested transfer was opposed also by Senator Brookhart, of Iowa; Senator Reed, of Missouri, and Senator Broussard, of Louisiana.

The corporation which is proposed is to be the recipient of the proceeds of a bond issue, which may not exceed $10,000,000. The money is to be used for the purchase of equipment, the construction and maintenance of terminals, and as a revolving fund.

Civil Engineers Appointed on Education Committee

President Loweth, of the American Society of Civil Engineers, has appointed as counselors representing the society on the board of investigation and co-ordination of the Society for the Promotion of Engineering Education, F. C. Shenehon, of Chicago, and J. Waldo Smith, of New York. This board is to study the whole subject of engineering education under a grant of $108,000 from the Carnegie Foundation, as announced in these columns some weeks ago.

Tacoma Revives Lake Cushman Power Project

The construction of the first unit of the Lake Cushman power project proposed by the city of Tacoma, Wash., is provided for in ordinances for the issuance of bonds and letting contracts introduced in the City Council. The ordinance, passed nearly three years ago, which provided for the development of the project must be amended to suit changes in the plan, and a new ordinance providing for $4,000,000 of light utility bonds is expected to be passed in time for a call for bids some time in the near future.

The Lake Cushman project called for an ultimate development of 140,000 hp. and an expenditure of $10,000,000. The first unit will develop 50,000 hp.

To Measure Water Diverted for New York Barge Canal

Measurement of the water passing through the New York barge canal is to be undertaken to determine whether water in excess of the amount needed for navigation is being diverted from the Niagara River. The work will be done by the measuring commission, recently appointed to represent the United States and Canada, the American member being Major P. S. Reinicke, district engineer in charge at Buffalo. W. M. Stewart represents Can .da.

It is contended by representatives of the federal government that no water is being diverted through the canal over and above the requirements for navigation, although in issuing a license to the Niagara Falls Power Co. it was assumed that 500 sec.-ft. of treaty water was going through the canal. Certain interests in Locknort and Medina have laid claim to the right to use this 500 sec.-ft. and have applied to the Federal Power Commission for a license to cover its use. Those interests hold a revokable state permit which recites their right to have this amount of treaty water transported through the canal as far as Lockport.

If it is found that no treaty water is being transported through the canal, it is assumed that the Federal Power Commission will license the 500 sec.-ft. for diversion at the Falls. Even in that event it is understood that the Niagara Falls Power Co. is willing to remunerate the holder of the state license for any equity which he may possess.

Trucks to Replace Way-Freight on P. R.R. Branch

Motor trucks have taken so much of the l.c.l. freight business in some thickly settled regions that the operation of such freight trains is no longer economical. To overcome this the Pennsylvania R.R. has announced that it will abandon this part of its way-freight service between Wilmington and Philadelphia, and has entered into an arrangement with a trucking organization for the required motor truck service in the territory affected. The railroad company's statement says that the new plan has enabled it to dispense with two freight trains daily, one in each direction. Two motor trucks are now doing the work of these trains with greater efficiency due to their flexibility and greater speed in movement. The new arrangement does not involve any changes in rates.

Cherokee Bluffs Power Project Well Under Way

Work on the new 132,000-hp. hydro-electric development of the Alabama Power Co. at Cherokee Bluffs on the Tallapoosa River is well under way. Four of the six miles of railroad which the company is building to the power site have been graded and track has been laid for three miles. The high-tension transmission line bringing power to the site has been completed and a 460-ft. section of the cofferdam in the river is ready to be unwatered.

The total head to be developed at this site will probably be increased from 120 ft. to 150 ft. for storage purposes. The first installation will be 44,000 hp.

Municipal Toll Bridge Over Ohio Proposed for Louisville

A report on the project for a new highway bridge over the Ohio River at Louisville has just been made by the bridge committee of the Louisville Board of Trade, embodying the specially interesting feature of a municipal toll-bridge plan. The report asserts the principle that those who use the bridge should pay the main part of its construction cost. It recommends locating the bridge at 10th St., connecting with Warner Ave. in Jeffersonville. The cost of the bridge is estimated at $4,790,000, or, with interest and contingencies, something over $5,000,000. The toll income that might be expected immediately after completion is estimated at $350,000 per year, which would assure a sufficient balance over fixed charges to provide for amortization.

Preliminary plans included in the report to the Louisville Board of Trade made by Fay, Spofford & Thorndike, consulting engineers, call for a structure of 17 steel spans carrying a concrete deck supporting a bituminous wearing surface. The sidewalk will be of concrete and concrete railings will be used. Excluding the approaches, the bridge will contain the seventeen 206-ft. spans and one 410-ft. span across the canal, and a 650-ft. span across the river channel. The total length of this portion of the bridge, which is practically level, is 4,663 ft.

The location of the bridge is about 1,500 ft. upstream from the Pennsylvania R.R. bridge, which it resembles in a general way. The roadway of the bridge will be 40 ft. wide with a 6-ft. sidewalk on the upstream side.

Regional Planning for Chicago 50-Mile District

The Chicago Regional Planning Association, organized Nov. 2 at the second conference on regional planning, is to serve the territory within fifty miles radius from the center of the city. This territory comprises what may be termed the Chicago industrial district and the purpose of the new association is to study conditions and promote co-operation in both industrial and social development, so that, for example, when a new industry is to be established the question of adequate local transportation, sanitary and housing conditions will not be overlooked.

Definite lines of activity by the association are to include the following: (1) A physical survey of topographical conditions, transportation, population and public utilities; (2) an industrial and commercial survey; (3) a health and housing survey as to water supply, drainage, sewerage, zoning regulations and housing conditions; (4) an educational survey of schools, parks, bathing beaches, forest preserves areas and commercial recreation facilities; (5) a governmental survey of the various governmental organizations within the region and a study of legislation.

The meeting elected Dwight H. Perkins as the first president. Three classes of membership are provided in the new constitution: individual, contributing and organization members, the last including county and municipal bodies and civic or community associations.

Retention of Construction Road Raises Common-Carrier Issue

Washington Correspondence

The application of the Portland Railway, Light & Power Co. for an amendment to its license which would allow it to retain the railroad which it built to its power development on the Clackamas River, 50 miles south of Portland, as a permanent adjunct to the development to insure the ready transfer of heavy machinery to the plant in case of accident, has raised the question as to whether such a permit should not require the operation of the road as a common carrier. The power project occupies a site in a very inaccessible part of the undeveloped forest area. The original plan called for the construction of a railroad to a point about 6 miles above the existing terminal at the company's Cazadero plant and the use of a wagon road for the remaining 20 miles. During construction, however, the company found it necessary to build the railroad all the way to the plant. This was done with the permission of local forest officials. These officials now object to the company retaining this railroad for emergency purposes unless it be operated as a common carrier. The power company has agreed to handle such shipments of forest products as are offered to it, but the Forest Service holds that the presence of the railroad along the only location suitable for a wagon road precludes the use of that location as a wagon road, and necessitates the operation of the railroad as a common carrier or else the removal of its rails.

Tramway and Light Railway Society to Meet at Paris

The International Congress of Tramways, Light Railways and Omnibuses will hold its next meeting at Paris in 1924. A preliminary list of subjects includes the following: (1) Improvements in track design and electric and mechanical operation of switches; (2) improvements in car design; motors and electrical equipment; loose wheels; radial axles; reduction in weight; brakes; (3) use of automobiles on rails; (4) transportation facilities in relation to the extension of towns and suburban districts; (5) employment and periodical examination of employees; (6) improvements in locomotives for light railways; fuel economy due to superheaters, feed-water heaters and other appliances; (7) motors for buses.

Largest Hydraulic Turbine Put in Operation

The first of three 70,000-hp. single-runner, vertical-shaft hydraulic turbines of the Niagara Falls Power Company's new plant in the Lower Gorge was put into service on Dec. 18. The new unit uses a flow of 3,200 sec.-ft., the amount now used by seven 5,000-hp. units in the old plant, with twice the output of that plant without any increase in the amount of water diverted from the Falls.

The runner is a single piece of cast steel weighing 105,000 lb. which, with the 32-in. shaft and the 399-ton rotor of the generator, make up the revolving element of approximately 500 tons weight suspended from the top of the unit by a Kingsbury thrust bearing.

Random Lines

Another Argument Gone

In New York the other day a prominent lawyer resigned from the Bar Association because lawyers do not "take enough interest in public affairs." Thus is shattered our fondest illusion and most potent argument for the bettering of the engineering profession. How are we going to argue for a more active participation in community life by the engineer if we cannot point dramatically to our lawyer-ridden government and the precedent lawyer-interest in public affairs.

* * *

An accounting for a water-works construction job came in a while ago with an item labeled "engineers and other odd expenses, $150."

* * *

False Pretenses

Some of the things in this column are meant to be funny. This item is *not*.

The following advertisement has been running for some time in a New York newspaper:

YOU CAN BE A DRAUGHTSMAN
Mechanical or Architectural
A Profession Not Overcrowded
Few months' spare time training under direct supervision of experts, which will not interfere with your present duties will qualify you in this well-paying profession.
Draughtsman earn $5,000 to $25,000 yearly. Let us show you how you can prepare for one of the many positions now open.
METROPOLITAN INST. OF DRAFTING
154 Nassau Street, Suite 610

It is hereby respectfully called to the attention of the postal authorities.

* * *

A Brutus Stroke

It looks as though we are going backward in our campaign against adjectival engineers. We are being attacked in the house of our friends. First comes the New York Section of the American Institute of Electrical Engineers with a program which announces a discussion on "human engineering" and a plea for intensive work in "membership engineering." And then the American Engineering Standards Committee sends a circular in which we are assured that "standardization engineering" is now a recognized profession in Germany and that advertisements for "standardization engineers" appear regularly in the engineering press. The morale of the technical press in Germany has probably suffered with everything else there. There isn't much they won't do for real money. But why countenance the debasing of the honest word "engineering" in this country? The Standards Committee finds, too, that "another most interesting development is the work of consulting engineers on trade catalogs." Add then to the immortals —"trade catalog engineers."

Engineering Societies

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual Meeting, Washington, D. C., Jan. 10-11, 1924.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual Meeting, New York, Jan. 16-18, 1924.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual Meeting, Chicago, Ill., Jan. 21-24, 1924.

ENGINEERING INSTITUTE OF CANADA, Montreal; Annual Meeting, Montreal, Jan. 22, and Ottawa, Jan. 23, 24, 1924.

AMERICAN CONCRETE INSTITUTE, Detroit, Mich.; Annual Meeting (20th anniversary), Chicago, Ill., Feb. 25-28, 1924.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago, Ill.; Annual Meeting, Chicago, March 13-15, 1924.

The North Carolina Section of the American Water Works Association at its recent meeting in New Bern, N. C., elected the following officers: President, J. C. Michie, superintendent of the Durham, N. C., water-works; vice-president, William H. Piatt, construction engineer, Durham; secretary-treasurer, Thorndike Saville, Chapel Hill.

Personal Notes

F. A. LAMMIMAN, formerly connected with the firm of Polk and Robinson, civil engineers of Chico, Calif., has been named city engineer of Chico, succeeding Frank S. Robinson, resigned.

C. F. PRICE, present city manager of San Mateo, Calif., has been appointed city engineer and superintendent of streets, succeeding G. Stanley Whitehead, who has been city engineer of San Mateo for four years and who recently resigned.

The JASPER-STACY CO., a new construction firm, has opened offices at 216 Pine St., San Francisco, and will engage in construction on irrigation, reclamation, power, factory, building, municipal and other enterprises. The firm is headed by B. P. LILIENTHAL, vice-president of the Union Sugar Co. and South San Francisco Land Co. The vice-president is O. W. JASPER, JR., manager of the Shattuck Construction Co. of San Francisco for the past seven years. The secretary is N. T. STACEY, engineer, whose most recent work involved the expenditure of $5,000,000 in townsite, railway and factory work.

WILLIAM ARTINGSTALL, consulting engineer, Chicago, has been made consulting engineer to the Department of Public Works, Chicago, reporting directly to Col. A. A. Sprague, commissioner. His duties include handling the city's supervision of the Illinois Central terminal, Union Station, and other railroad terminals, in addition to all matters coming to the commissioner by special ordinance.

J. E. MOODY, engineer in charge for the city of Chicago on the development of the Illinois Central R.R. terminal, has resigned.

A. J. GOODE has been appointed county engineer of Red River County, Texas, succeeding J. B. Reiman, who has resigned. County engineering headquarters are at Clarksville.

J. P. KEARBY has been appointed county engineer of Fayette County at La Grange, Texas, succeeding CAPT. A. SCHLAFI, who becomes a division engineer for the Texas State Highway Department.

H. G. FLURY and R. A. KIZER have opened an office at 125 Wirthman Bldg., Kansas City, Mo., under the firm name of Flury & Kizer, engineers, for the practice of structural engineering. Mr. Flury was formerly with the Kansas City Terminal Ry., the Kansas City Structural Steel Co. and the Interstate Commerce Commission.

GEN. WILLIAM LUTHER SIBERT has been appointed president and general manager of the Alabama Dock Commission to succeed the retiring temporary commissioner, George Gordon Crawford. Gen. Sibert served as a member of the Isthmian Canal Commission from March, 1907, until April, 1914, and as chairman of the Board of Engineers on the flood prevention work in the Huai River valley, China. He was promoted to the rank of brigadier general and was extended the thanks of Congress by an act approved March 4, 1915. Shortly after the outbreak of war in 1917 he was promoted to the rank of major general and sent to France with the First Division. Following this he served in the Chemical Warfare Service from May, 1919, until February, 1920.

ARTHUR E. LODER, district engineer of the U. S. Bureau of Public Roads, who has been in charge of federal aid work in the southeastern district of the United States, has been selected as manager of the Good Roads Bureau of the California State Automobile Association, succeeding C. C. Cottrell. Mr. Loder, after graduation from Purdue University, was for some years chief engineer of the Los Angeles Highway Commission and division engineer for the California State Highway Department.

F. D. HUDGINS, state highway engineer of South Dakota, has resigned, effective Jan. 1, 1924. His successor has not yet been appointed.

JAMES F. SANBORN and CLINTON L. BOGERT, consulting engineers, have formed a partnership, with office at 30 Church St., New York City, and are prepared to design, report on and supervise construction of water supplies, sewers and sewage disposal, tunnels, concrete structures and municipal works. Mr. Sanborn, a graduate of Harvard University, was connected with the construction of the Battery tunnel of the New York subway and the northern aqueduct department of the N. Y. Board of Water Supply (Catskill aqueduct). Mr. Bogert, a graduate of Cornell, has been engineer in the design division of the Board of Water Supply, New York City, on tunnel and reservoir work. He is co-author with Alfred D. Flinn of a handbook of water supply.

R. DE CHARMS, of Oil City, Pa., has been appointed resident engineer on the construction of a highway bridge across the Allegheny River at Oil City, for Venango County. Mr. de Charms was formerly assistant bridge engineer for the New Jersey State Highway Commission, at Newark, N. J.

JOHN A. FOCHT, recently county engineer of Rockwall County at Rockwall, Texas, has been appointed county engineer of Nolan County at Sweetwater. Nolan County has just voted a large bond issue for highway construction. Mr. Focht is an engineering graduate of the University of Texas and was an engineer officer in the late war. Formerly he was city engineer of Sweetwater in charge of extensive waterworks and paving improvements.

SAMUEL REA, president of the Pennsylvania Railroad Co., has been elected president of the Long Island Railroad Co., to succeed Ralph Peters, deceased. George Le Boutillier, whose election to the presidency of the Long Island Railroad was announced in error some weeks ago, continues as vice-president of the company in charge of all matters concerning operation.

HUBBELL, HARTGERING & ROTH is the name of a firm of consulting engineers recently organized in Detroit, Mich., and composed of CLARENCE W. HUBBELL, J. MCRAE HARTGERING and ALBERT ROTH. The firm will specialize in water supply, sewerage and municipal engineering. Mr. Hubbell was city engineer of Detroit from 1917 to 1922. The address of the new firm is 2346 Penobscot Bldg., Detroit.

S. L. WONSON, bridge engineer of the Missouri Pacific R.R., has been appointed assistant chief engineer, succeeding the late H. R. Carpenter.

F. E. BATES has been appointed bridge engineer of the Missouri Pacific R.R., succeeding S. L. Wonson promoted to assistant chief engineer.

Obituary

ISAAC WINSTON, hydrographic and geodetic engineer, inspector in charge of the Geodetic Field Station in New York City, died recently in his 71st year. Since 1878 he had been in the service of the United States Coast and Geodetic Survey.

GEORGE E. STEELE, civil engineer, who was prominent in engineering in Wisconsin for many years, died Dec. 6 in Grass Valley, Calif., where he has lived in retirement for two years. He was 81 years old. He located in Los Angeles some years ago and designed the streets and sewer system of the city of Hermosa Beach, Calif. Mr. Steele was a native of Ohio.

LOUIS BACQUE, civil engineer, Newmarket, Ont., died in that city Dec. 9 at the age of 67 years. He was a native of Bordeaux, France, and went to Canada forty years ago, where he practiced civil engineering in Montreal and Toronto. He was an authority on the use of peat for fuel.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Interviews with Industrial Executives—4

Close Contact with Job Aids Design and Operation of Trench Excavators

H. C. McCardell, general manager of the Parsons Co., Newton, Ia., explains how ideas from the field are capitalized in improved design and how demonstrators aid contractors in starting work right.

FROM a heavy, unwieldy steam-driven machine mounted on wood rollers, the trench excavator, in a comparatively short time, has been developed into a compact, mobile, all-steel unit powered by a gasoline engine and operated on crawler treads. Notwithstanding these improvements, the demand for faster-digging machines of greater mobility even now necessitates periodic changes in design to keep the machines abreast of general progress in the construction field. This is a subject to which the Parsons Co., Newton, Iowa, manufacturer of trench excavating and backfilling machinery, attaches great importance. In an interview with *Engineering News-Record's* representative, H. C. McCardell, general manager of the company, stated that it has been the practice of his organization to replace an old design by an entirely new one every five years. This means the introduction of a new machine each year, as the equipment is made in five standard sizes to meet ordinary demands for ranges of work. These five sizes are designed for trenches having widths of 18, 30, 40, 48, and 78 in.

Close contact with the equipment on the job is the foundation of the Parsons Co.'s service to its customers, which begins with the design of the machine. Through its twenty-nine branch offices and agents in the United States and Canada, regular travel by its sales engineers and special trips by members of its designing staff, operating difficulties under actual morking conditions are noted and corrected and improvements in design made.

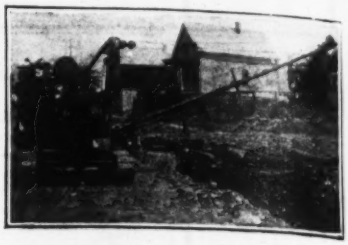
"This policy of contact with the job," Mr. McCardell explained, "has proved of great value both to our company and to the users of our equipment. A case in point is the development of the side-cutting attachment for use on our trenching excavators. The idea was brought back to the factory by one of our operators who was demonstrating a machine for a contractor. The contractor had conceived the idea of this device for increasing the width of cut of the buckets and was experimenting with it on his work. It was something entirely new at that time and when our engineering staff received a detailed report on this attachment an improved design was worked out and the device made regular equipment on all of our trench excavators."

On another occasion, Mr. McCardell added, a Parsons salesman was visiting a contractor in Nebraska who was using a backfiller for a trench in a narrow alley—only 16 ft. wide. The backfiller is equipped with a long boom which makes difficult operation in restricted quarters. This contractor, however, had devised an attachment which solved the problem and, with his permission, the company incorporated this feature in subsequent designs of its machine.

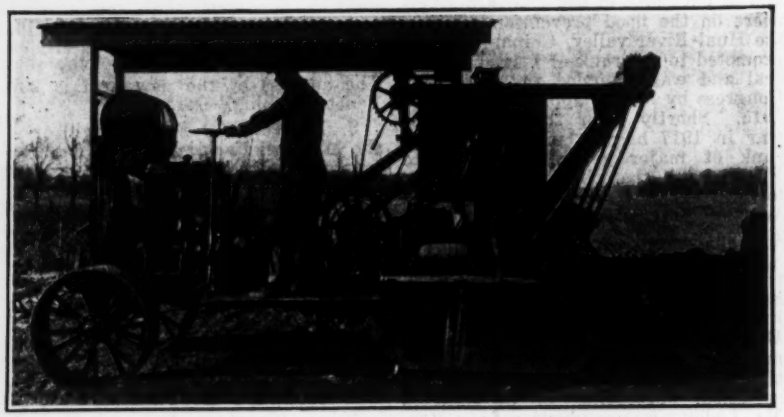
"Ours is a policy of give and take," Mr. McCardell continued. "We get many valuable suggestions from the contractor, and, in the same spirit of co-operation, we offer advice which our experience indicates will aid him in his work. A case of this sort happened when one of our engineers was visiting a contractor in the Middle West doing work in winter. The ground was frozen and he was using picks to dig ahead of his trenching machine. Our engineer suggested that he pipe his exhaust steam ahead, using a cover of straw or manure to thaw out the ground. The contractor adopted this suggestion and made a substantial saving in time and labor."

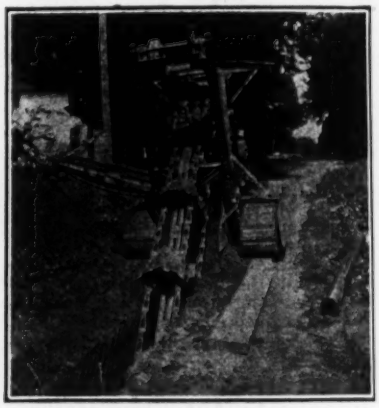
Supplementing this policy of continuing improvements in design resulting from job contact, the company's plan of co-operation with contractors includes these additional features: (1) Investigation of local ground conditions before a sale to prevent the use of a trench excavator on work for which it is not adapted; (2) shop and field tests of equipment before shipment; (3) operating instructions on the job by one of the company's demonstrators; (4) detailed printed instructions and blueprints; and (5) adequate and prompt supply of repair parts even for machines of out-of-date design.

"We never sell a machine to a customer where there is any doubt as to its ability to do the work in a satisfactory and economical manner," said Mr. McCardell. "Where ground conditions are not suitable we advise a customer against using a trench excavator and recommend such other equipment as, in our estimation, is best suited for the work. The pursuit of such a policy, of course, requires competent men in the sales department whose experience and good judgment may be depended upon for a correct recommendation to the prospective buyer. We believe it is good business to think of the ultimate results to be gained by the purchaser rather than the immediate profits to be secured by the company."



DEMONSTRATING CORRECT OPERATION OF TRENCH BACKFILLER





EACH EXCAVATOR IS TESTED AT THE COMPANY'S PLANT (LEFT) BEFORE IT IS ALLOWED TO BEGIN WORK ON THE JOB (RIGHT)

A machine is never permitted to leave the company's shops in Iowa until it has been thoroughly inspected and tested. When it reaches the contractor, therefore, it is ready immediately to go to work. The shop inspection concerns itself principally with checking to see that the alignment of working parts is true and that the driving chains run straight. After this examination has been made the excavator is taken out to a 10-acre testing lot behind the company's shops and made to dig a trench of the maximum width and depth for which the machine is designed. On this test all parts are trued up and adjustments made to insure the satisfactory operation not only of the digging buckets but of the cleaner and conveyor.

The company considers it good insurance to have its machines started right on the job. It has been found that the hardest time to satisfy the customer is when the machine is starting its work. For that reason the company sends one of its trained operators—from three to five of these men are regularly employed—to the work where each excavator is shipped. This man supervises the unloading of the machine and instructs the contractor's operator in proper methods of handling it. The company also maintains a list of skilled trenching machine operators from which a man can be supplied to the contractor if desired for permanent employment.

In addition to this personal instruction, the company sends out with each machine detailed printed instructions and blueprints, together with lists of parts, each being illustrated by a photograph and numbered so as to avoid confusion in ordering duplicates.

To Avoid Trouble

As the result of observing the operation of hundreds of trenching machines the company has noted that, where trouble occurs, it can usually be traced to one of the following causes due to neglect on the part of the owner:

Failure to keep boxes tightened up.
Loose bolts.
Gears out of alignment.
Improper lubrication.
Neglect of bevel-gear adjustment.
Use of chains in which links, pins and bushings are worn out.
Neglect, during the winter, to paint the machine and grease the shafting and gears.
Allowing the excavator to remain out in the open all winter instead of placing it under cover.

When the company is advised, by the reports of its field representatives, that owners are not maintaining their machines in good operating condition letters are written to them calling attention diplomatically to these shortcomings.

The shop equipment and organization of the Parsons Co. is lined up for rapid production of parts, even those that may be out of style. The policy is to keep on hand a stock of repair parts for all machines that have ever been built by the company. As part of this service the company operates its own electric steel foundry, so that it is possible to make any particular kind of steel needed for different parts of trenching machines. However, customers are advised to maintain on the job an adequate stock of repair parts.

Business Notes

Barber Asphalt Co., Philadelphia, announces the opening of a new district office at 807 Phelan Building, San Francisco, in charge of Major C. M. Foster, former representative of the company in Washington, D. C.

Chicago Pneumatic Tool Co., New York, announces the General Machinery Company of Spokane, Wash., as its agents in the eastern part of Washington and northern part of Idaho.

Sandusky Cement Co., Cleveland, Ohio, announces the election of J. B. John as president and general manager. His connections with other companies will remain as formerly.

Receivers of the Sizer Steel Corp., Buffalo, N. Y., C. B. Porter, John T. Dillon, and Stewart F. Hancock, announce that the manufacture of all kinds, grades and finishes of commercial forgings has been resumed in addition to the company's output of rolled bars, die blocks, oil well steels, and spiral stems.

Eastern Paving Brick Manufacturers Association, at its fifth annual meeting in New York Dec. 11, re-elected the following officers: President, R. L. Winslow; treasurer, R. T. Hutchins; secretary and chief engineer, William C. Perkins.

Kettle River Treating Co., Madison, Ill., reports that improvements are being made to the plant recently acquired. About 10 acres of land for storage space have been leased and supplied with tracks, while an additional area is being graded and the entire yard covered with cinders. This plant has equipment for both zinc and creosote treatment and also for adzing and boring ties.

Copper & Brass Research Corp., New York, at its third annual meeting held in New York recently, elected the following officers: President, R. L. Agassiz, Calumet & Hecla Consolidated Copper Co.; vice-presidents, B. F. Kelley, Anaconda Copper Mining Co.; F. S. Chase, Chase Metal Works; Walter Douglas, Phelps Dodge Corp., H. J. Rowland, Rome Brass & Copper Co., and U. G. Hungerford, Hungerford Brass & Copper Co.; treasurer, Stephen Birch, Kennecott Copper Corp., secretary, George A. Sloan; manager, William A. Willis.

In designing the different sizes of machines parts are made interchangeable in so far as possible. This is particularly true of sprockets and chains. This policy enables the owner to carry a minimum stock of repair parts and often saves him loss of time due to shutdowns.

A recent improvement has been the use of removable sprocket teeth. In case of a break a single tooth may be taken out and another substituted without removing the sprocket from its shaft. Also, to withstand increased wear, bushings and pins on chains have been made of manganese steel.

"Our whole policy of service," Mr. McCardell concluded, "is built up on the theory that a satisfied customer is our best advertisement."

Equipment and Materials

Inserts in Concrete Carry Angles Supporting Brick Veneer

For anchoring face angles to carry brick veneer in concrete skeleton construction Truscon adjustable pressed steel inserts have been used recently as a substitute for bolts. Where it has been common practice to drill the wooden forms for the insertion of the bolts to carry these face-angles, David J. Johnson, a superintendent of con-

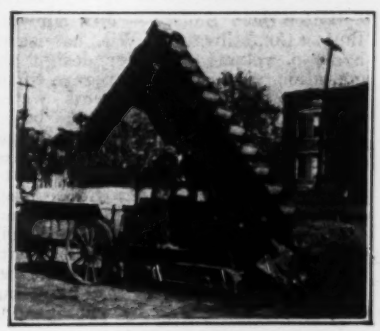
struction in Chicago, devised the new method of construction in a series of six large apartment hotels in Chicago to save money in erection costs. A saving of $3 per hundred in favor of the insert is claimed. The following unit costs are taken from a study of the contractor's time sheets.

	Cents	
With Bolts		
Carpenter's time locating and drilling holes and placing bolts at 87½c. per hour	13	
Bolts, ¾ x 9 in	5	
Extra nut to hold bolt upright angles to the forms	1	
		19
With Special Inserts		
¾ in. pressed steel insert	11	
1½ in. bolt to fasten face angles	2½	
Placing insert	2½	
		16
Saving in form of inserts		3

Bolts may be bent when struck by large scaffolding timbers, thus necessitating rethreading and they are often ½ in. or more out of line due to the sag in the concrete forms. With the insert an inch of adjustment is obtained and angle irons can be attached without the necessity of punching a new hole, even though the beam sags slightly. A bit of mortar is put in the bottom of the insert to provide a bearing surface. Mr. Johnson found that an insert should be placed on each side of the column to carry the angle across the face of the column, and used at every floor level.

Improvements in Creeper Loader

Three improvements are embodied in the new model of creeper loader, manufactured by the George Haiss Manufacturing Co., Inc., New York. The width of the feeding element has been



increased from 7 to 8 ft., which more than doubles the clearance at the side of the creeper element. The machine also has been equipped with an improved type of heavier clutch. The third innovation is the use of a new design of tread link which renders the overlap self-cleaning and does away with any possibility of injury to bituminous pavements.

Among the former design features retained in the new model are the steel-plate feeding propellers, 2-ft. crowding speed, toothed buckets and completely inclosed transmission and clutches. The machine weighs 14,000 lb. and is equipped with a 37-hp. Waukesha gasoline engine.

Reducing Idle Time in Haulage

The problem of keeping motor equipment in continuous operation is intensive when the load must be handled piece by piece as in the case of lumber or iron pipe, or other products in small units. The accompanying illustration shows how, through

the use of a semi-trailer, the truck and its driver are kept constantly on the move in transporting dressed lumber.

The semi-trailer, made by the Trailmobile Co., Cincinnati, is parked on its own wheels with the front supported by a pair of jacks while the lumber is being loaded. When the trailer has its full cargo, the motor truck—which meanwhile has been busy hauling another trailer—backs under it. The fifth wheel or turn-table mechanism which is mounted on the truck and is provided with lift skids projecting to the rear automatically lifts the jacks free of the ground. The fifth wheel mechanism automatically connects the truck with the trailer. The jacks are swung up away from the ground to give ample road clearance and the entire outfit is immediately under way to make delivery.

Publications from the Construction Industry

Water-Tube Boilers — THE KIDWELL BOILER CO., Milwaukee, Wis., has issued a 208-p. volume on boiler design and operation, particularly in regard to the Kidwell two-flow ring-circuit water-tube boiler. This type of boiler, claimed to represent "a great advance over any previous design," is based on a principle of circulation discovered by Goldsworthy Gurney, the Cornish engineer, in 1826, but said to be not generally embodied in water-tube boilers. The design of such boilers, with numerous modifications, is described in full and illustrated by numerous drawings, as well as by photographs.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Bridge Construction This Year and Last

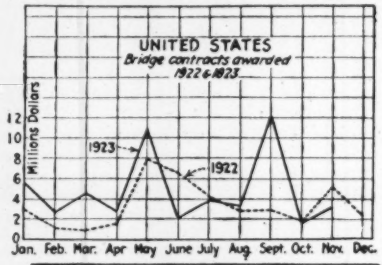
Statistics from *Engineering News-Record* covering bridge contracts of $25,000 and over show two peaks in 1923, in May and in September. The May peak may be explained by looking at the chart of the Far West. During the month a 6-mi. drawbridge over San Francisco Bay costing $10,000,000 was awarded. This of course is reflected on the chart of the United States.

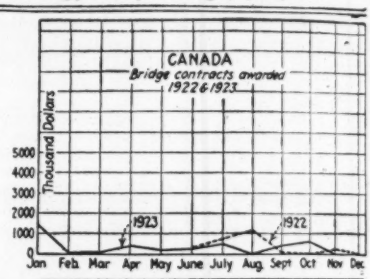
The September peak was due to work in the Far West and the South. During this month the Far West awarded a contract of $4,500,000 for the bridge over Carquinez Straits; a 2,480-ft. double-track steel railroad bridge over St. John's River, costing $1,800,000, and a 1,733-ft. concrete bridge with two steel bascules over the Ashley River, costing $1,067,466. Except for these two peaks both the 1923 and 1922 curves are fairly regular.

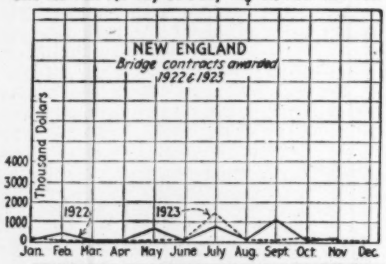
During the first eleven months of these two years, 1922 had 379 awards with a total value of $42,137,000 compared with 346 for 1923 valued at $61,069,000. The average value of each award for 1922 was $111,179 against $176,500 for 1923. The trend of bridge construction may be gathered from the figures of the past five years:

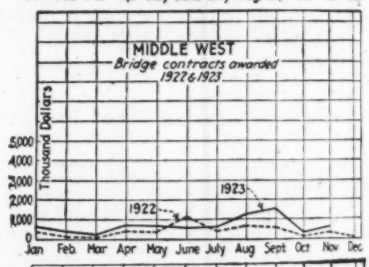
Year	Total	Total for 11 Months	Monthly Average
1919	$27,143,669	$26,555,346	$2,414,123
1920	35,213,881	33,199,984	3,018,180
1921	27,330,677	25,341,282	2,303,753
1922	43,477,000	42,137,000	3,830,636
1923	.....	58,196,000	5,290,545

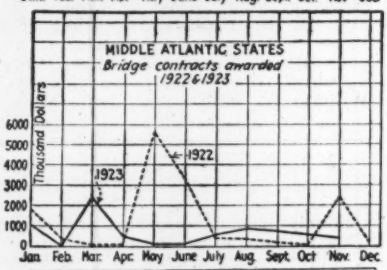
The total for the eleven months of 1923 exceeds the yearly total of any of the four preceding years and gives a monthly average of over $5,000,000. The total for the last month of this year will place 1923 as one of the record years in bridge construction. A contract has just been awarded for a bridge over the Raritan River, at Perth Amboy, N. J., costing $3,702,922.

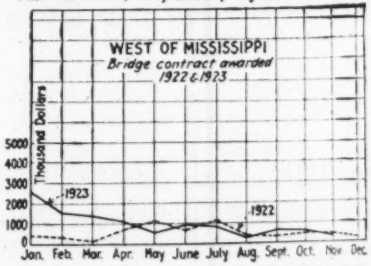

UNITED STATES
Bridge contracts awarded 1922 & 1923
Millions Dollars
1923
1922
Jan. Feb. Mar. Apr May June July Aug. Sept. Oct. Nov. Dec.

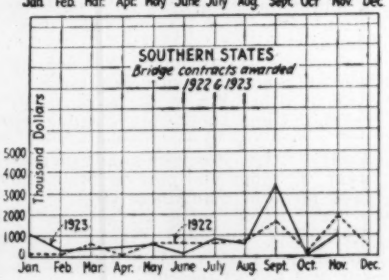


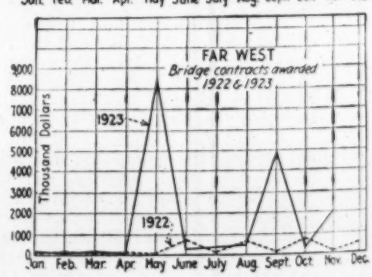

NEW ENGLAND
Bridge contracts awarded 1922 & 1923
Thousand Dollars
1922
1923
Jan. Feb. Mar. Apr May June July Aug. Sept. Oct. Nov. Dec.


MIDDLE WEST
Bridge contracts awarded 1922 & 1923
Thousand Dollars
1922
1923
Jan. Feb. Mar. Apr May June July Aug. Sept. Oct. Nov. Dec.


MIDDLE ATLANTIC STATES
Bridge contracts awarded 1922 & 1923
Thousand Dollars
1923
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


WEST OF MISSISSIPPI
Bridge contract awarded 1922 & 1923
Thousand Dollars
1923
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


SOUTHERN STATES
Bridge contracts awarded 1922 & 1923
Thousand Dollars
1923
1922
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.



The situation as to bridge construction in the various sections is given by the following comparison of the number and value of the awarded contracts for the first eleven months of 1922 and 1923:

	1922		1923	
	No.	Value	No.	Value
New England	21	$2,341,000	18	$3,667,000
Middle Atlantic	50	16,325,000	40	8,891,000
Southern	75	8,130,000	67	9,255,000
Middle West	56	5,173,000	61	8,341,000
West of Mississippi	136	6,858,000	119	11,293,000
Far West	41	3,310,000	41	19,622,000
Total	379	$42,137,000	346	$61,069,000

E. N.-R. Construction Volume Index Number for 1919 has just been computed. It is 91, compared with 100 in 1913. The full list for every month of the last five years will appear in the January 3 issue.

Lumber Exports 47 Per Cent Heavier Than in 1922

The Department of Commerce reports the total of October exports of wood and wood manufactures is valued at $10,340,863 against $8,271,513 of October, 1922, or a gain of nearly 25 per cent. The total value for the first ten months of 1923 reached $119,652,815 compared with $81,350,155 for the same period of last year showing an increase of 47 per cent. Some of the items exported during October are:

Logs—7,986,000 ft. of cedar; 1,124,000 ft. of Douglas fir, and 216,000 ft. of Southern yellow pine.

Hewn and Sawn Timber—30,785,000 ft. of Douglas fir, 11,247,000 ft. of Southern yellow pine, and 1,891,000 ft. of Cedar.

Lumber—Boards, planks, and scantlings amounted to 127,844,000 ft.

The balance consisted of cooperage stock, plywood, veneers, lath, and shingles.

Brief Analysis of Construction Volume in Peak-Cost Year

In 1920, the year of peak prices, industrial and commercial building construction amounted to 68 per cent of the total construction, according to *Engineering News-Record*. Street and road contracts aggregated 17 per cent of the total, with other classes as follows: water-works, 2 per cent; sewers, 2.3; bridges, 2.2; Federal Government, 2.3; other work, 6.2.

The heaviest month was October, when value contracts awarded was 14 per cent of the total for the year. In the first six months 61.2 per cent of the year's work was placed under contract. The slowest month was November, 4.8 per cent.

Public Bond Sales Still Active

The October activity of the bond market extended into November. The *Commercial and Financial Chronicle* reports the total of state and municipal bonds for November to be $93,462,693; while the October total was $83,561,277 and September $52,251,368.

State bonds took a prominent place in November's offerings. North Carolina led with an aggregate of $15,649,500. California's sale of $6,000,000 was second.

The harbor improvement bond of the City of Los Angeles for $5,000,000 was the largest municipal award.

The total of all forms of obligations placed in November during the past five years follows:

1919	$729,703,393
1920	139,313,577
1921	180,831,418
1922	92,504,602
1923	142,503,175

In the accompanying table of representative bonds, five were sold at par, one below par, and the remainder above. The yields range from 4 to 6 and the rate of interest from 4 to 6 per cent.

The single 4 per cent issue was in Pennsylvania and the five 6s in Michigan, Oregon, New Mexico, Ohio and Washington, respectively.

Insolvencies Among Manufacturers on Increase

The number of commercial insolvencies in the manufacturing industries throughout the United States, during November, shows a gain compared with the same period in 1922, according to R. G. Dun & Co. The number of defaults among dealers or traders, however, are considerably below the total for November of last year.

Lumber manufacturers showed the greatest gains (17 per cent) in insolvencies, compared with last year, while machinery makers came next, with an increase of 8 per cent.

Fewer manufacturers of paints and oils failed during November of this year. Defaults among traders in these commodities, however, increased about 17 per cent.

Glass manufacturing interests and iron foundries showed exactly the same number of insolvencies in November as during the corresponding period last year.

Freight Traffic Reaches New High Record

A new high record in the amount of freight carried was made by the railroads of the United States during the first nine months of this year, according to reports recently filed by the carriers with the Bureau of Railway Economics.

The freight traffic for that period amounted to 343,796,799,000 net ton miles. This was an increase of 2.79 per cent over the corresponding period in 1920 when the previous record was made, and which amounted to 334,457,000,000 net ton miles.

Compared with the first nine months of 1918 when freight traffic was greatly stimulated by the war, the total from Jan. 1 to Oct. 1 this year was an increase of 4.86 per cent. It also was an increase of 31 per cent over the corresponding period last year, when freight traffic was affected by the strikes of both miners and shopmen.

REPRESENTATIVE BOND SALES DURING NOVEMBER

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Dated	Maturity	Purchased By
Oregon		$175,320	4½	101.57	4.63	Dec. 1, 1923	1943—1959	Ralph Schneeloch Co. and others
County								
Hudson, N. J.	Road	986,000	4½	100	4½	Aug. 1, 1923	1924—1942	A. M. Lamport & Co., New York
Lapea, Mich.	Boulevard	386,000	4½	100	4½	Aug. 1, 1923	1924—1938	E. E. Macron & Co.
	Road	45,000	6	100.40	5.98			
Lucas, Ohio	Sewer	138,872	5½	101.70	5.17	Nov. 15, 1923	1925—1933	Provident Savings Bank & Trust Co. and others
	Sewer	54,541	5½	102.50	5.01	Nov. 15, 1923	1925—1933	
	Road	52,910	5½	102.50	5.01	Nov. 1, 1923	1925—1933	
	Road	51,851	5½	102.50	5.01	Nov. 1, 1923	1925—1933	
	Water supply	47,149	5½	102.60	4.99	Nov. 15, 1923	1925—1933	
	Road	51,851	5½	102.50	5.01	Nov. 1, 1923	1925—1933	
	Road	21,163	5½	101.95	5.05	Nov. 1, 1923	1925—1933	
	Road	7,195	5½	101.16	5.17	Nov. 1, 1923	1925—1929	
	Water supply	29,755	5½	102.20	5.04	Nov. 1, 1923	1925—1932	
	Water supply	29,808	5½	102.20	5.04	Nov. 15, 1923	1925—1932	
	Road	9,739	5½	101.11	5.19	Nov. 1, 1923	1925—1929	
	Water supply	3,739	5½	100.55	5.32	Nov. 15, 1923	1925—1927	
	Water supply	57,016	5½	102.72	4.97	Nov. 15, 1923	1925—1933	
	Sewer	45,565	5½	102.28	5	Nov. 15, 1923	1925—1933	
Pulaski, Ind.	Ditch improvement	35,950	5	102.71	4.51	Dec. 15, 1923	1925—1934	Fletcher Amer. Co., Indianapolis
Washington, Ore.	Improvement	30,000	6	98.12	6.35	Dec. 1, 1923	1928—1932	Ralph Schneeloch Co., Portland
Craven, No. Car.	School	165,000	5½	101.57	5.11	Oct. 15, 1923	1924—1953	John Nuveen & Co., Chicago
Municipality								
Albuquerque, N. Mex.	Paving	$140,000	6			Oct. 1, 1923	1927—1934	Hanchett Bond Co., Chicago
Ashtabula, Ohio	Sewage disposal	$200,000	5½	104.531	5.02	Oct. 1, 1923	1924—1948	Herrick Co., Cleveland
Iron Mountain, Mich.	Storm drain	62,500	6	101.81	5.34	Oct. 1, 1923	1924—1928	W. L. Slayton & Co., Toledo
Lubbock, Tex.	Water works	$390,000	5	100	5	Jan. 1, 1926	1946	Hanchett Bond Co., Chicago
Plymouth, Ind.	Sewers and water works	125,000	5½	101.28	5.43			Bregg, Garrett Co., Dallas
Rockwood, Pa.	School	50,000	5	101.82	4.77	Dec. 29, 1923	1924—1943	Fletcher American Co., Indianapolis
Sanford, Fla.	Street improvement	$10,000	4	100	4	Oct. 1, 1928	1948	Citizens of the City
Sayreville, N. J.	Park and sewerage	160,000	5½	100.54	5.47	Jan. 1, 1924	Jan. 1, 1954	Seasongood & Mayer, Cincinnati
Seattle, Wash.	Sewer	149,000	5	100.80	4.94	Dec. 15, 1923	1925—1963	M. M. Freeman & Co., Philadelphia
Stoneham, Mass.	Paving, sewers, walks	64,916	6	100	6	Nov. 20, 1923	1923	
	School	147,000	4½	101.393	4.08	Nov. 1, 1923	1924—1945	Kidder, Peabody & Co., Boston

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 335 to 345, are the following:

Club, Philadelphia, Pa., Penn Athletic Club, $2,500,000.

Office, Huntington, W. Va., Coal Exchange Bldg. Co., $1,000,000.

Apartment Hotel, New York, N. Y., Warinick Corp., $2,000,000.

Hospital, Ft. Worth, Tex., Ft. Worth Methodist Hospital, $1,000,000.

Oil Removal Plant, Milwaukee, Wis., Dept. of Pub. Wks., $1,500,000.

Industrial Plant, Toledo, O., Libbey-Owens Sheet Glass Co., $1,000,000.

Railroad, Oregon, Southern Pacific Co., 7 mi. section to cost between $2,000,000 and $3,000,000

Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 335 to 345, are the following:

High School, Hartford, Conn., to Southern New England Contg. Co., $1,170,125.

Office, Philadelphia, Pa., to Stone & Webster, $3,000,000.

Theatre, Bank and Office, Flint, Mich., to Wells Bros. Constr. Co., $2,500,000.

High School, St. Louis, Mo., to H. C. Gerhard Bldg. Co., $1,240,000, heating and ventilating to Sodeman Heating & Power Co., $156,447; plumbing to H. D. M. Doerner, $93,315; total $1,489,762.

Improvement, Clearwater, Fla., to Davis Miller, Cone Bros., and Peninsula Constr. Co., $2,413,858.

Bids desired on 40,000 cu.yd. of trench excavation on drainage system by Winterbottom-Connelly Co., 17,316 Madison Ave., Cleveland, Ohio.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Dec. 6; the next, on Jan. 3.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.40	$3.30	$3.55	$4.20	$3.60	$4.10	$4.25
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.25	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	3.38	3.20	3.45	3.85	3.65	4.10	4.00
Steel pipe, black, 2½ to 6 in. lap, discount	44%	40%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.43
Cast-iron pipe, 6 in. and over, ton	61.60@63.60	54.75	61.00	57.20@60.20	60.50	—66.00	59.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	—2.50@2.60	2.35	2.05	2.10	2.42	2.84	2.61	2.90	2.25
Gravel, ¾ in., cu.yd.	2.00	1.75	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.20	2.00	2.00	+1.25@1.50	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	1.90	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+59.00	37.00	54.75	55.50	+44.75@46.00	41.75	—38.00	29.50	42.00
Lime, finishing, hydrated, ton	18.20	23.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	1.85	1.50	1.50	2.70	2.10	2.80	9.50
Common brick, delivered, 1,000	+23.65	11.00	11.60	11.00	16@18	12.00	15.50	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.10	.11	.0724	.075	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.10	.11	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	.95	.95	1.05	.94	1.01	+1.10	1.03	1.15	1.38
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.62½	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.40@.45	.35@.50	.50	.62½	.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on white pine lumber, free on cars at mill. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.50). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Changes Since Last Week

Buying is everywhere upon a conservative basis, owing to the tendency shown by most buyers to close the year with light reserve stocks of materials.

While there has been no decline in building trades wages, some concessions are forthcoming in materials prices. The lower prices in question are designed principally to induce a greater volume of winter building and also to give the dealers a chance to cover against the spring rush for building materials and consequent mill and transportation congestion.

There is evidence, however, of a slight upward tendency in prices of materials used in the latter stages of the construction of a building.

The lumber market is taking on a firmer tone in most centers, although telegraphic advices from San Francisco announce a drop of $3 per M. ft. in Douglas fir timbers.

Common brick are quoted at $20 per M. wholesale, alongside dock, New York, against $19, one week ago. The winter reserve stocks are low, with danger of navigation in the Hudson River being closed at any time by freezing weather. This would of course cut off the supply of Hudson common brick in the midst of a period of active demand. The unusual supply of used brick from building demolition, as well as importations have not as yet affected the price of first grade domestic brick.